Cardio Menu
Operator Manual

AT-2plus Memory 6-Channel ECG unit

Service Handbook

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AT-2*plus Memory* Service Handbook

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Associated Documents

Guide to the SCHILLER Interpretation and Measurement Program E/ D/ F	Article No.	2. 510 179
SCHILLER AT-2*plus* User Guide - English / German / French	Article No.	2. 510 220
SCHILLER AT-2*plus* User Guide - Italian / Spanish / Portuguese	Article No.	2. 510 221

CE 0124 93/42/EEC Medical Devices:
0124 `Notified Body` DEKRA AG

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Diagnostic System:	**Cardiovit AT-2*plus Memory***
Serial numbers starting with:	040.
Year of manufacture:	1997 Onwards

We, the undersigned, hereby declare that the medical device (class IIa) specified above conforms with the essential requirement listed in Annex 1 of EC Directive 93/42/EEC.

This declaration is supported by:

Certificate of approval No.:	11425-01	ISO 9001 (Rev.1994) EN 46001 by SQS
	45112-60-01	ISO 9001/08.94 EN 46001 / 12.93 by DEKRA and
	45112-16-01	Annex II, Section 3 of the Directive 93/42/EEC

CE 0124

Baar (Switzerland) Dated 20.05.1998

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Warranty

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In case of a defect, contact your dealer or the manufacturer.

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* assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by him, and

* the *AT-2plus Memory* and approved attached equipment are used in accordance with the manufacturers instructions.

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Safety Notices

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TO PREVENT ELECTRIC SHOCK DO NOT DISASSEMBLE THE UNIT. NO SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL ONLY.

DO NOT USE THIS UNIT IN AREAS WHERE THERE IS ANY DANGER OF EXPLOSION OR THE PRESENCE OF FLAMMABLE GASES SUCH AS ANAESTHETIC AGENTS.

IF THE DISPLAY IS DAMAGED, A LEAKAGE OF FLUID MAY OCCUR. DO NOT INHALE THE VAPOUR FROM THIS FLUID AND AVOID CONTACT WITH MOUTH AND SKIN. IF CONTACT IS MADE, CLEAN CONTAMINATED AREA IMMEDIATELY WITH FRESH WATER.

THIS PRODUCT IS NOT DESIGNED FOR STERILE USE.

SWITCH THE UNIT OFF BEFORE CLEANING AND DISCONNECT FROM THE MAINS.

DO NOT, UNDER ANY CIRCUMSTANCES, IMMERSE THE UNIT OR CABLE ASSEMBLIES IN LIQUID.

DO NOT OPERATE THE UNIT IF THE EARTH CONNECTION IS SUSPECT OR IF THE MAINS LEAD IS DAMAGED OR SUSPECTED OF BEING DAMAGED.

DO NOT USE HIGH TEMPERATURE STERILISATION PROCESSES (SUCH AS AUTOCLAVING). DO NOT USE E-BEAM OR GAMMA RADIATION STERILISATION.

DO NOT USE SOLVENT CLEANERS

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THIS UNIT COMPLIES WITH EMC REGULATIONS FOR MEDICAL PRODUCTS WHICH AFFORDS PROTECTION AGAINST EMISSIONS AND ELECTRICAL INTERFERENCE. HOWEVER SPECIAL CARE MUST BE EXERCISED WHEN THIS UNIT IS USED WITH HIGH FREQUENCY EQUIPMENT.

IT MUST BE ENSURED THAT NEITHER THE PATIENT NOR THE ELECTRODES (INCLUDING THE NEUTRAL ELECTRODE) COME INTO CONTACT WITH OTHER PERSONS OR CONDUCTING OBJECTS (EVEN IF THESE ARE EARTHED).

THERE IS NO DANGER WHEN USING THE ECG UNIT FOR A PACEMAKER PATIENT OR WITH SIMULTANEOUS USE OF OTHER ELECTRICAL STIMULATION EQUIPMENT. HOWEVER, THE STIMULATION UNITS SHOULD ONLY BE USED AT A SUFFICIENT DISTANCE FROM THE ELECTRODES. IN CASE OF DOUBT, THE PATIENT SHOULD BE DISCONNECTED FROM THE RECORDER.

Safety Notices

WARNINGS & CAUTIONS

THIS UNIT IS CF ⊣♥⊢ CLASSIFIED ACCORDING TO IEC 601-1. THIS MEANS THAT THE PATIENT CONNECTION IS FULLY ISOLATED AND DEFIBRILLATION PROTECTED. SCHILLER CAN ONLY GUARANTEE PROTECTION AGAINST DEFIBRILLATION VOLTAGE, HOWEVER, WHEN THE ORIGINAL SCHILLER PATIENT CABLE IS USED.

WHEN NON-MEDICAL DEVICES ARE CONNECTED TO THE RS-232 INTERFACE ENSURE THAT BOTH UNITS ARE SECURELY CONNECTED TO THE SAME EARTH POTENTIAL.

WHEN OPERATING THE UNIT ON BATTERY AND SIMULTANEOUSLY USING NON-MEDICAL DEVICES, THE RS-232 INTERFACE MUST BE FULLY ISOLATED.

AN EXTERNAL DEVICE MUST ONLY BE CONNECTED USING THE ORIGINAL SCHILLER INTERFACE CABLE ASSEMBLY.

BEFORE USING THE UNIT, ENSURE THAT AN INTRODUCTION REGARDING THE UNIT FUNCTIONS AND THE SAFETY PRECAUTIONS HAS BEEN PROVIDED BY A SCHILLER REPRESENTATIVE.

THE GUIDELINES FOR PATIENT ELECTRODE PLACEMENT ARE PROVIDED AS ON OVERVIEW ONLY. THEY ARE NOT A SUBSTITUTE FOR MEDICAL EXPERTISE.

THIS UNIT IS PROVIDED FOR THE EXCLUSIVE USE OF QUALIFIED PHYSICIANS OR PERSONNEL UNDER THEIR DIRECT SUPERVISION. THE NUMERICAL AND GRAPHICAL RESULTS AND ANY INTERPRETATION DERIVED FROM A RECORDING MUST BE EXAMINED WITH RESPECT TO THE PATIENTS OVERALL CLINICAL CONDITION. THE RECORDING PREPARATION QUALITY AND THE GENERAL RECORDED DATA QUALITY, WHICH COULD EFFECT THE REPORT DATA ACCURACY, MUST ALSO BE TAKEN INTO ACCOUNT.

IT IS THE PHYSICIANS RESPONSIBILITY TO MAKE THE DIAGNOSIS OR TO OBTAIN EXPERT OPINION ON THE RESULTS, AND TO INSTITUTE CORRECT TREATMENT IF INDICATED.

What's in this book

The service philosophy for the *AT-2plus Memory* is fault finding to module level. The purpose of this book is to provide all the information necessary to enable the service engineer to efficiently locate and replace a faulty module. This book assumes no detailed knowledge of the *AT-2plus Memory* but does require that the service engineer is familiar with standard workshop practices. The book is divided into the following chapters:

Chapter 1 - Operating Elements

The purpose of this chapter is to provide an easy reference for all the main operator functions and to give a basic introduction to the *AT-2plus Memory*. This chapter gives details of the operator controls with the operation and function of each key briefly explained. The information in this chapter provides a background to the operating functions only. Complete operating information is provided in the SCHILLER *AT-2plus* User Guide.

Chapter 2 - Functional Overview

This chapter provides a functional overview of the *AT-2plus Memory*. The description is supported by functional block diagrams.

Chapter 3 - Fault Diagnosis

This chapter provides a guide to locate a fault to module level. The diagnostics are presented in a logical sequence of fault finding algorithms and procedures. Illustrations are provided to support the text where needed.

Chapter 4 - Module Removal and Replacement

This chapter gives an overview of the physical construction of the *AT-2plus Memory* with the main physical attributes of the unit briefly described. The physical description is supported by illustrations showing the internal location of all modules. Removal and replacement instructions for all removable modules are also provided in this chapter. Each procedure is autonomous with details of tools, jumper settings, adjustments and settings or special requirements that are required before and after replacement. Functional checks that must be carried out after replacing a module are also provided.

Chapter 5 - Adjustments

This chapter provides all adjustments and settings. Also detailed in this chapter are basic functional test procedures that can be performed to check the functioning of the unit.

Chapter 6 - Spare Parts

This chapter provides the part numbers and reordering information for all replaceable modules. Also included in this chapter are details of any special test equipment or special tools required for adjustment or fault finding procedures.

What's in this book

Chapter 7 - Technical Data

The full technical specification of the *AT-2plus Memory* is given in this chapter.

Chapter 8 - Glossary

This chapter explains all the acronyms and signal titles used in this book and in the *AT-2plus Memory* circuit diagrams.

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Circuit Diagrams & Board layouts

The circuit diagrams and component layouts are provided for all boards. These details are provided for information only.

We need your help

The philosophy of SCHILLER is one of continuous improvement. Our aim is to provide the user with the most up-to-date information and the latest technological developments.

Your suggestions and comments are welcome on all SCHILLER documentation. Please contact the SCHILLER Technical Documentation Department.

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Chapter 1
Operating Elements

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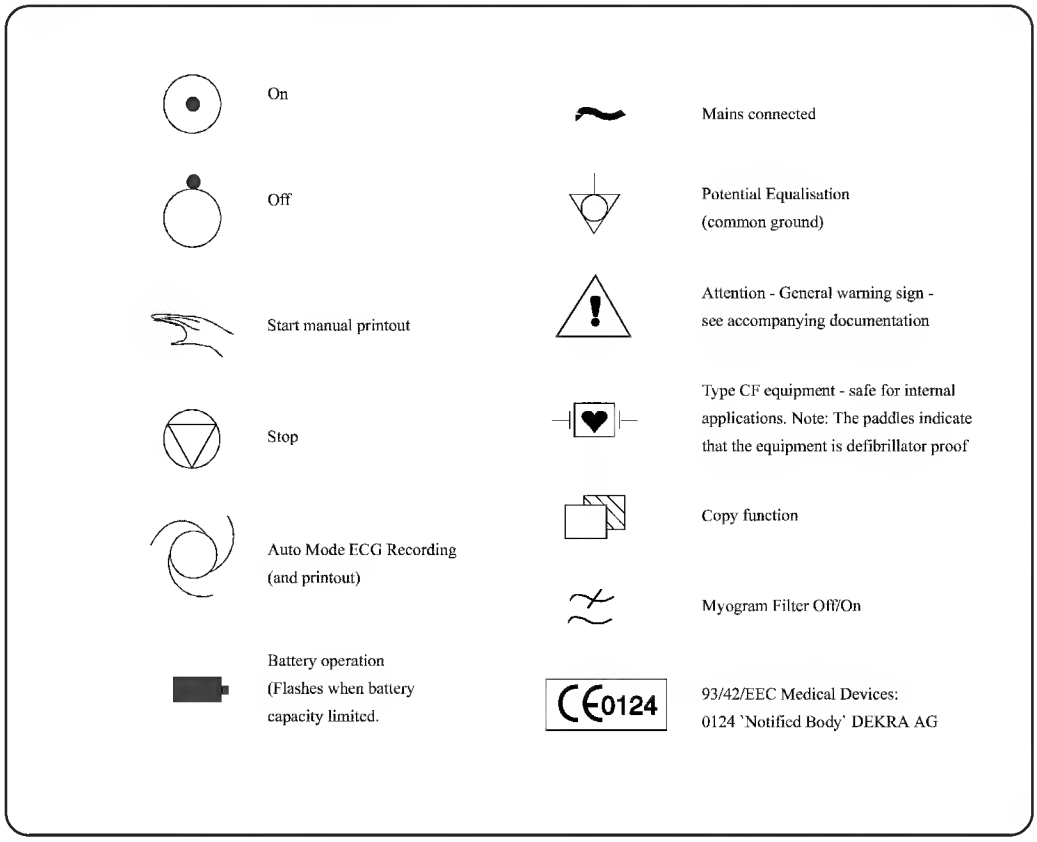
Introduction

The CARDIOVIT AT-2*plus* is a 6-channel ECG recorder with all (12) ECG signals simultaneously processed to provide instant ECG recordings. Two automatic recording modes can be individually preset to enable one button ECG recording of preferred print formats.

The AT-2*plus* includes the following features:

- Low weight and compact dimensions
- Large A4 size printout from integrated quality thermal printer
- Built-in rechargeable battery for mains-independent use - 4hrs normal use or 300 printouts on one battery charge
- Large, clear LCD for ECG preview prior to printing
- Simple one key operation for main functions
- Automatic or manual recording modes
- Selectable printing formats
- ECG memory for easy copying
- Interpretation program option (including measurements) for children and adults
- Alphanumeric keyboard for patient data entry and clinical comments

List of Symbols



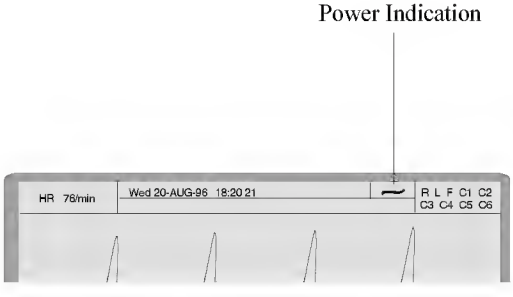
Location & Power

Location

Do not keep or operate the apparatus in a wet, moist, or dusty environment. Also, avoid exposure to direct sunlight or heat from other sources. Do not allow the unit to come into contact with acidic vapours or liquids, as such contact may cause irreparable damage. The unit should not be placed near X-ray or diathermy units, large transformers or motors. The unit must be placed on a flat surface and must not be operated in areas where there is any danger of explosion.

Power Supply

The mains connection is on the rear of the unit. The mains indicator lamp on the keyboard is always lit when the unit is connected to the mains supply. The unit can either be operated from the mains supply or from the built-in rechargeable battery. The power source isa indicted on the top line of the LCD.



When mains is connected a mains symbol is displayed (as shown above). When the unit is running on battery power a battery symbol is displayed:

When battery capacity is limited, the battery symbol flashes on and off.

To recharge the battery, connect the apparatus to the mains supply by means of the supplied power cable. A totally discharged battery needs less than 15 hours to be fully recharged (60% in less than 3 hours, 90% in less than 7 hours). A fully charged battery gives approximately 4 hours of normal use. The unit can remain connected to the mains supply without any danger of damage to either the battery or the unit.

Switching On and Off

The CARDIOVIT AT-2*plus* is switched on with the green ON key

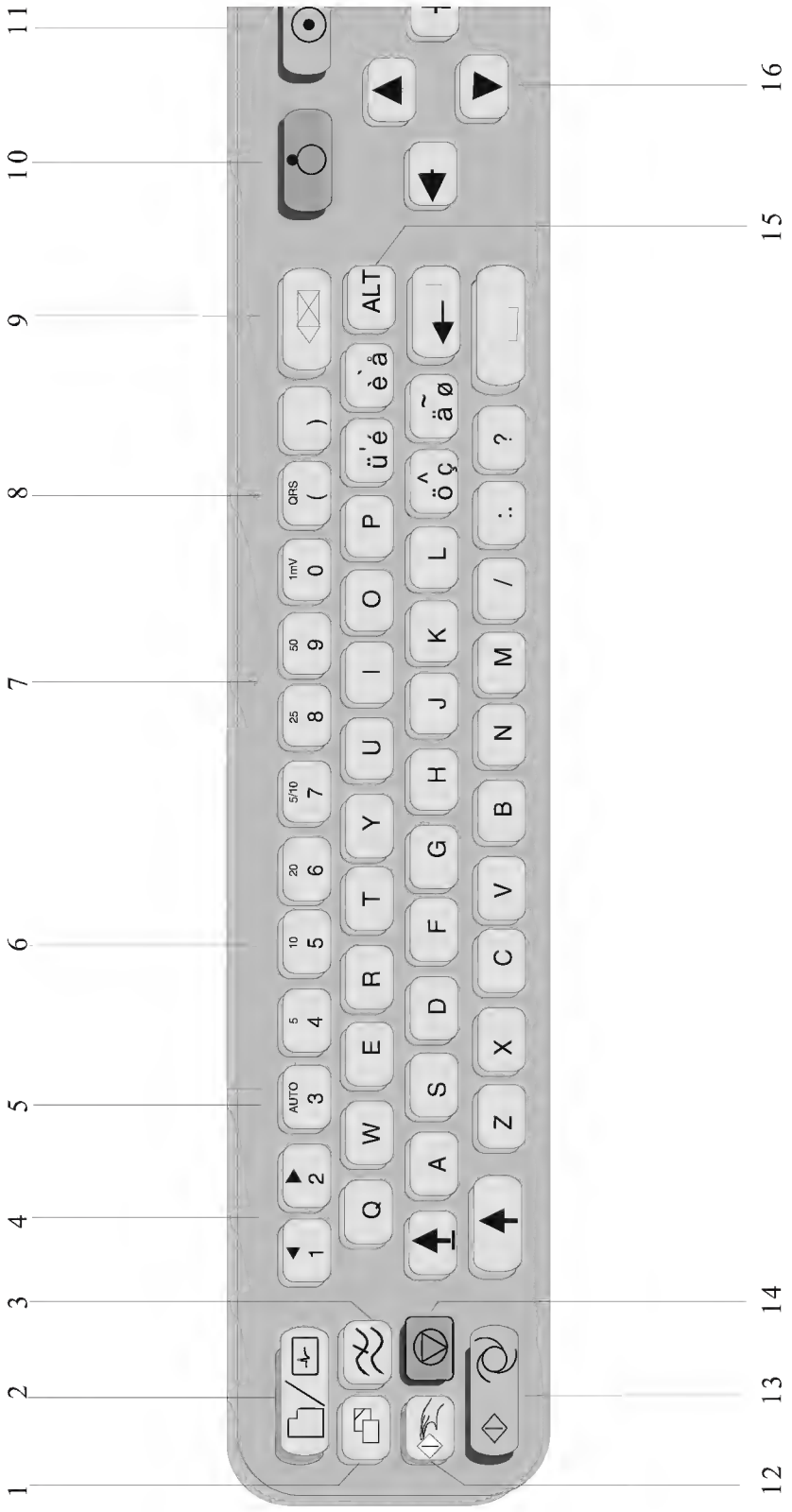
and off by means of the red OFF key

The unit is automatically switched off after 5 minutes (30 seconds if battery capacity is limited) if no key is pressed and the patient cable is not connected.

Potential Equalisation

If the AT-2*plus* is used in conjunction with other patient connected equipment, we recommend that the potential equalisation stud on the rear of the unit is connected to the hospital/ building common ground with the yellow/green ground cable (Part-no. 2.310005). When working from an emergency vehicle, the vehicle common ground can be used.

The Keyboard



The Keyboard (cont.)

1 Print extra copy - *of Auto mode recording currently in memory.* Press the ALT key first followed by this key to obtain a copy in Auto format 2.

2 Display/enter patient data. When the patient data is displayed, pressing this key again returns to the ECG. Use the up/down arrows to go to the next data entry field.

In the `Born` (date of birth field), only the patients year of birth need be entered if desired. When two digits are entered (patients year of birth), the AT-2plus calculates the age of the patient according to the year entered. When the full DOB is entered, the age is calculated precisely.

---

3 Myogram filter ON / OFF. The cutoff frequency can be defined and is detailed in `Settings`.

4. The top figures on the number keys designated > and < changes the lead group displayed on the screen.

5. Auto sensitivity key - automatically sets the ECG printout sensitivity (in AUTO mode only) to the best setting for the signal strength (5mm/mV or 10mm/mV)

6. The top figures on the number keys designated 5, 10, and 20 set the sensitivity of the ECG both on the screen and on the (manual) printout. The sensitivity is 5, 10 or 20 mm / mV.

7. The top figures on the number keys designated 5/10, 25, and 50 set the speed of the ECG both on the screen and on the (manual) printout. The speed on the screen can only be set to 25 or 50 mm / s. The speed of the manual printout can be 5, 10, 25 or 50 mm/s. The 5 and 10 mm/s settings are both on the same key which toggles the two speeds.

8. The top character `QRS` toggles the QRS beeper ON/ OFF

9. Delete last typed character.

10. Switch the unit OFF.

11. Switch the unit ON.

12. Manual mode recording - start continuous printout of ECG - until STOP key pressed

13. Auto Mode recording (in Auto mode 1). Press ALT followed by the AUTO key for auto mode 2.

14. STOP printout / confirm (new) setting

15. ALT key - key for initiation of setups and selection of second format for printout and auto mode recording

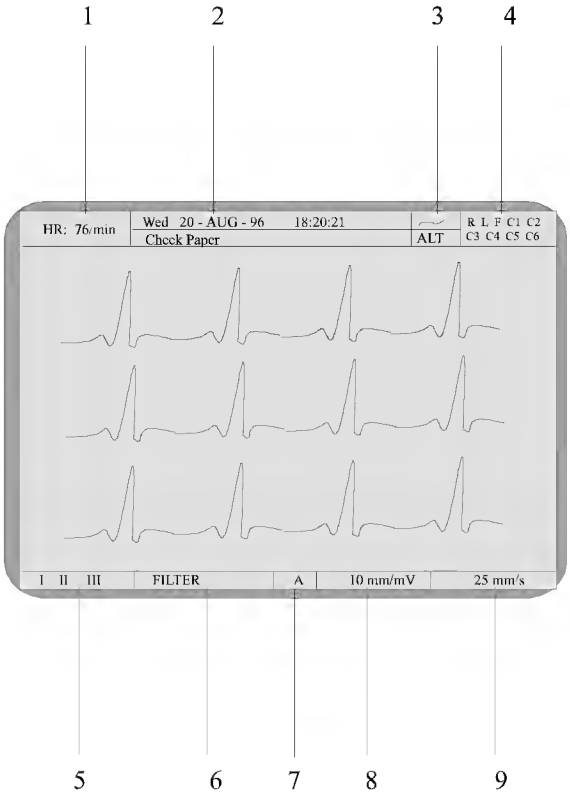
16. In ECG mode use the UP/DOWN arrows to adjust screen contrast. When entering patient data use the LEFT/RIGHT arrow keys to move cursor in data field. Use the UP/DOWN arrow keys to go up/down to the next data entry

17. Mains Indicator - lit when mains connected.

Second letters on the keyboard - è, é, ç, ø are reached by holding the ALT key pressed before the letter key. Accents on a letter e.g. ô, ñ etc. are reached by pressing <SHIFT> and then the letter. In addition the following special characters are available (AT-2plus Memory only !):

Key combination: SHIFT +	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*0*
Character	*!*	*@*	*#*	*$*	*%*	*&*	*/*	***	*"*	*=*

LCD Screen



1. Current Heart Rate (averaged over 4 beats and refreshed every 2 seconds). The HR is also given on a manual printout. *Note that with an auto mode printout the HR is averaged over the full 10 seconds of the recording.*

2. Top line - Current Day, Date and Time

   Bottom Line - System messages

3. Top Line - Current power source - mains or battery. When battery capacity is limited the battery symbol flashes.

   Bottom line - `ALT` in this box indicates that the ALT key has been pressed.

4. Electrode connections - when a lead flashes it indicates that the electrode resistance is too high. The electrode must be reapplied

5. Lead indication (leads currently displayed on the screen). Change the lead group with the keys `1` and `2`.

6. Myogram Filter indication - `Filter` = filter ON; no indication = filter OFF. Switch the filter on or off with the Filter key.

7. An `A` in this box indicates that automatic sensitivity is selected (auto mode printout only). Switch automatic sensitivity on or off with key `3`.

8. Sensitivity - 5, 10 or 20 mm/mV. Change the sensitivity with the keys `4`, `5`, and `6`.

AT-2plus Short Form Operating Instructions

Automatic ECG Recording

- Prepare skin, hook up patient.
- Switch unit on, press ON .
- Press and enter patient data.
- Press again and wait for at least 10 seconds until a clear and stable trace is displayed.
- Press AUTO to record and print.
- Press COPY for additional copies.

Manual ECG Recording (Rhythm Strip)

· Prepare skin, hook up patient.

- Switch unit on, press ON .
- Press MAN START .
- Change lead group with and .
- Press STOP to stop the printout.

Electrode hook-up check

· Press for electrode check.

Best results are obtained when the electrode voltage readings (right column) are between ±50mV.

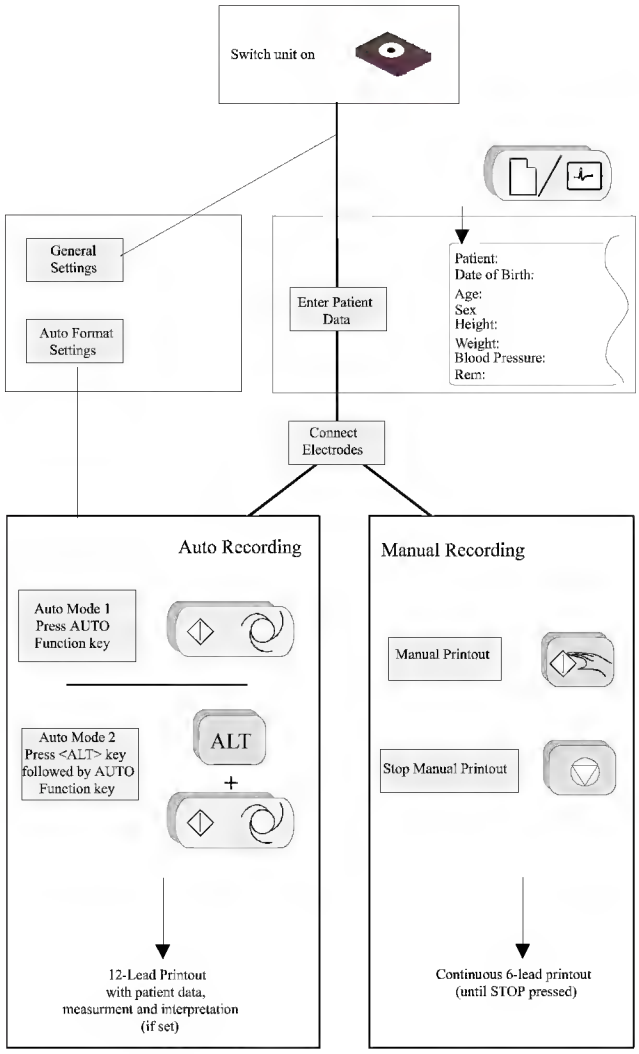
Filter On/Off

- Press to switch the (Myogram) filter On / Off.

System Configuration

- Press to print system settings.

Modes of Operation



Automatic Mode

Automatic Mode provides a printout giving 10 seconds of ECG recording of all 12 leads with a choice of 2 different formats.

Lead format and chart speed can be programmed freely for each of the 2 formats before recording.

With the optional interpretation program installed it is also possible to select the measurement table, average cycles with optional markings and interpretation statements for the printout.

For further information see paragraph `Settings for Automatic Mode`.

Manual Mode

Manual Mode provides a real time printout of 6 leads that are selected and indicated on the screen.

The following can be freely selected before or during recording:

- Lead Group
- Chart Speed
- Sensitivity
- Myogram Filter

For further information see paragraph `ECG Recording in Manual Mode` following.

Automatic Mode

In **automatic mode**, a full 12-lead ECG is printed in one of two predefined formats with a sensitivity of 10 mm/mV. These two formats are selected by the user to suit his specific needs and requirements.

When the AUTO SENSITIVITY key

is pressed before recording in automatic mode, the unit detects very large waveform amplitudes and sets the sensitivity for the extremity and/or precordial leads to 5 mm/mV to reduce the overlapping of traces. An `A` on the bottom line of the LCD indicates that Auto sensitivity is set.

To start the automatic ECG recording in Format 1, press the AUTO key:

To start the automatic recording in the second format, press the ALT key followed by the AUTO key:

The printout gives the following:

- ECG recording of all leads in either Standard or Cabrera format according to selection
- Sensitivity
- Heart Rate
- Speed
- Filter Settings
- Time and Date
- Interpretation statements
- Average Cycles
- Intervals
- Axis
- Sokolow Index (ECG index for hypertrophy)
- Detailed Measurement Table

To obtain an extra printout of the ECG recording in Format 1, simply press the COPY key:

COPY

To obtain an extra printout of the second format, press the ALT key followed by the COPY key:

ALT - COPY

The Auto mode settings for the two formats are detailed in the paragraph entitled `Settings for Automatic Mode` later in this book

Manual Mode

Manual mode provides a direct printout of the real-time ECG with full control of parameter selection.

To start the manual recording of a real-time ECG, press the MANUAL Printout key

To stop the manual recording (printout) press the STOP key

The printout provides you with the following:

- Six (selected) leads with lead identification.
- On the lower edge, the chart speed, user identification and filter settings (if on).
- At the top, the heart rate as current average of 4 beats, trace sensitivity, and the time and date

The following can be freely chosen during or before the recording:

Lead Group by means of the LEAD FORWARD and LEAD BACKWARD key

The following lead groups are selectable:

- I, II, III aVR, aVL, aVF

  (Cabrera: aVL, I, -aVR / II, aVF, III)
- VI, V2, V3 / V4, V5, V6
- II, aVF, III / V2, V4, V5
- V4, V5, V6 / V7, V8, V9

Note: The LCD only displays three leads at one time. When the lead forward or lead backward key is pressed, the following /preceding three lead group is displayed

Manual Mode (cont.)

Chart Speed

Select speed 5, 10, 25 or 50mm/s by means of the SPEED keys:

Notes:

Key 7 is a toggle key -press once and 5 is selected, press a second time and 10mm/s is selected.

When the 25 or 50mm/s key is pressed, the same speed is set on both the screen and the (manual) printout. When 5 or 10 mm/s is selected, this affects the manual printout speed only.

Sensitivity

Select 5, 10 or 20 mm/mV by means of the SENSITIVITY keys:

Myogram Filter

Switch the filter ON or OFF with the FILTER key:

`FILTER` is displayed on the bottom line of the LCD when the filter is switched on.

Recentering

To re-centre the ECG traces, press the 1mV key

WARNING

AFTER HEAVY ARTEFACTS OR LEAD OFF, THE INDICATION OF THE HEART RATE MAY NOT BE RELIABLE.

Settings

Each parameter is set by means of a code. This code comprises a combination of keys starting with the **ALT** key followed by two or three numbers. The setting is confirmed with the **STOP** key. As soon as the **ALT** key is pressed, the keyboard is dedicated to the programming function.

Note: *When the ALT key is pressed `ALT` appears on the LCD (see previous page)*

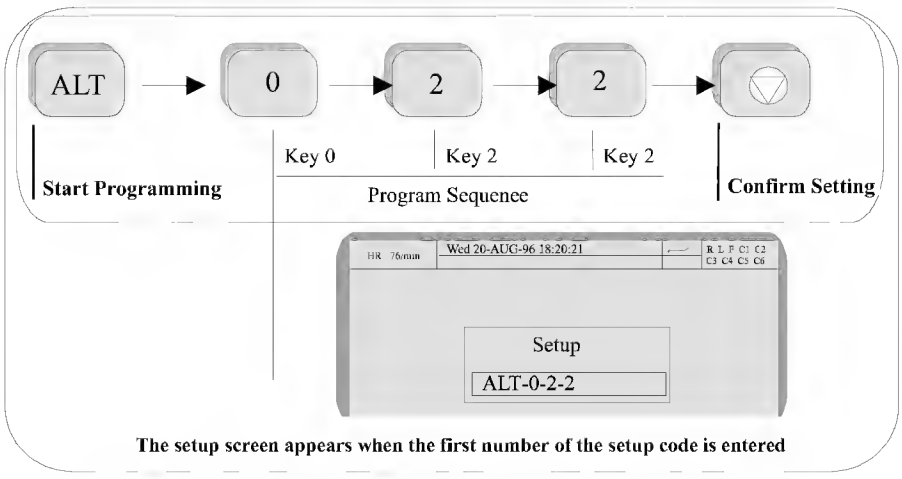
Note: *The Alternative (ALT) function is only active for 4 seconds. If a programming key is not pressed within 4 seconds, the unit reverts to standard mode. The ALT key must again be pressed to activate the programming mode*

The setting is remembered and the keyboard released for other functions when the **STOP** key is pressed. Once a setting has been confirmed, it is stored in the memory even when the unit is switched off.

Example

If you want to set the language on your AT-2*plus* to English, the key sequence given on the table (see page 18), is ALT; 0; 2; 2. STOP.

On the following pages the programmable parameters and the programming sequences are described in detail.



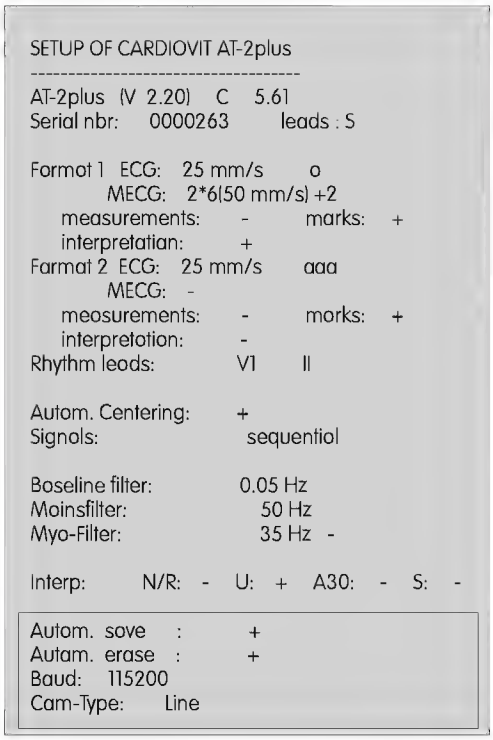
The setup screen appears when the first number of the setup code is entered

Settings (cont.)

The defined formats and settings for your unit can be checked as follows:

ALT - 0 - 1 - 1

A printout of the defined settings will be produced and gives the following information, depending on the installed software:



Only volid for AT-2plus Memory !!

Unit designation	Software version, Software option installed (C = Interpretation) and interpretation version
Serial number	Serial number of the unit
Leads	Standard (S) or Cabrera (C)
ECG Format	Long (ooo), Short (o) or Suppressed (-)
MECG	Average cycles as defined in auto ECG recording setup (e.g. 4 * 3 (25 mm/s) + 2)
Measurements	Enabled (+) or Suppressed (-)
Marks	Enabled (+) or Suppressed (-)
Interpretation	Enabled (+) or Suppressed (-)
Selected Rhythm leads	Leads selected for R1, R2 resp.
Automatic Centering	Enabled (+) or Suppressed (-)
Printout of signals	Sequential or Simultaneous
Baseline Filter	0.05, 0.15 or 0.30 Hz
Mains Filter	50, 60 Hz or OFF (-)
Myogram Filter	25 or 35 Hz, ON (+) or OFF (-)

Settings (cont.)

Interpretation settings: N/A:+/- 'normal/abnormal' is written (+) or suppressed (-)
U:+/- 'unconfirmed report' is written (+) or suppressed (-)
A30:+/- patient age is assumed to be < 30 (-) or >30 (+)
S: +/- low (-) or high (+) sensitivity

For AT-2plus Memory only:

Automatic Save Enabled (+) or Suppressed (-)

Automatic Erase Enabled (+) or Suppressed (-)

Baud Data transmission speed (9600 - 115200 bit/s, see page 1.25)

Com-Type Communication mode, Line or Modem (see page 1.25)

Default Settings

To reset the unit to the basic default settings, proceed as follows:

ALT - 0 - 6 - 6

Settings	S = Standard	C = With Interpretation
Language	As set	As set
Leads	Standard (S)	Standard (S)
Auto Format 1	ECG: 25mm/s, short (o)	ECG : 25mm/s, short (o)
		MECG: 2*6 (50mm/s + 1)
		Measurements: Suppressed (-)
		Interpretation: Enabled (+)
		Marks: Enabled (+)
Auto Format 2	ECG: 25mm/s, Long (ooo)	ECG : 25mm/s, long (ooo)
		MECG: suppressed (-)
		Measurements: suppressed (-)
		Interpretation: disabled (-)
		Marks: Enabled (+)
Rhythm Leads	V1	V1, II
Autom. Centering	Enabled (+)	Enabled (+)
Printout of signals	Sequential	Sequential
Baseline Filter Setting	0.05Hz	0.05Hz
Mains Filter Settings	50Hz (60Hz)	50Hz (60Hz)
Myogram Filter Setting	25 Hz, 35Hz, OFF	25 Hz, 35Hz, OFF
Interpretation Settings		N/A: Suppressed (-)
		U: Enabled (+)
		A30: Under thirty (-)
		S: Low (-)

Settings (cont.)

Language

The language is selected as follows:

Language Selection					
Entry Key Sequence				*Language*	*Confirm*
ALT	0	2	1	German	Press STOP key
			2	English	
			3	French	
			4	Swedish	
			5	American	
			6	Italian	
			7	Spanish	
			8	Portuguese	
			9	Russian	

Confirm the selection by pressing

STOP

Notes: *The difference between English and American is the mains filter setting - English = 50Hz; American = 60Hz and the physical units.*

Note: *The language setting for the AT-2plus Memory depends on the software version which has been loaded (see page 1.27)*

User Identification

The user identification is printed on all recordings. The user ID can be the department, doctor or hospital etc. Enter the user ID as follows:

Press the ALT key followed by key 9, 3, 3

ALT - 9 - 3 - 3

The user entry field is displayed on the LCD. Enter up to 30 characters via the keyboard.

Confirm the new user ID by pressing the ENTER key.

Settings (cont.)

Filters

There are three different filters which can be set individually as follows:

- Baseline filter
- Mains filter
- Myogram filter

Baseline Filter

The digital **Baseline filter** suppresses excessive baseline drifts. The setting options are as follows:

Baseline Filter				
Entry Key Sequence			*Filter Setting*	*Confirm*
ALT	5	0	0.05 Hz (default)	Press STOP key
		1	0.15 Hz	
		3	0.30 Hz	

Confirm the selection by pressing

STOP

Note: The set value is the lower limit of the frequency range and is normally set to 0.05 Hz. The settings 0.15 and 0.30 Hz should only be used when absolutely necessary, as the possibility exists that they could affect the original ECG signal, especially the ST segments.

Mains Filter

The **Mains filter** is an adaptive digital interference filter designed to suppress AC interference without attenuating or distorting the ECG.

Set the mains filter in accordance with the frequency of your local mains supply as follows:

Mains Filter				
Entry Key Sequence			*Filter Setting*	*Confirm*
ALT	8	5	Mains Filter 50 Hz	Press STOP key
		6	Mains Filter 60 Hz	
		9	Mains Filter Off	

Settings (cont.)

Myogram Filter

The **Myogram filter** suppresses disturbances caused by strong muscle tremor. The set value will be the new upper limit of the frequency range as soon as the **FILTER** key is pressed on or programmed as default when the unit is switched on. When the Myogram filter is on `Filter` is displayed on the bottom line of the LCD.

Myogram Filter				
Entry Key Sequence			*Setting*	*Confirm*
ALT	8	2	Myogram Filter 25 Hz	Press STOP key
		3	Myogram Filter 35 Hz	
		1	Myogram Filter active when the unit is first switched on (marked on printout with +)	
		8	Myogram Filter off when the unit is first switched on (marked on printout with -)	

Confirm the selection by pressing the **STOP** key

STOP

The myogram filter is switched on and off manually with the **FILTER KEY**

Note: *An ECG recorded in auto mode is stored unfiltered. It is therefore possible to print the stored ECG either with or without passing the myogram filter. Filter ON is indicated in the bottom information line of the LCD. When the **FILTER** key is pressed again, the filter is switched off and the `Filter` indication on the bottom information line of the LCD is removed. The cutoff frequency of the myogram filter is set to either 25 or 35 Hz.*

Settings (cont.)

Defining Lead Sequence & Printout

The required settings can be selected as follows:

Sequences, Print & Auto-centering				
Entry Key Sequence			*Definition*	*Confirm*
ALT	7	1	Standard Lead Sequence	Press STOP key
		2	Cabrera Lead Sequence	
		3	Simultaneous Print	
		4	Sequential Print	
		5	Auto-centering ON	
		6	Auto-centering OFF	

Confirm the selection by pressing the STOP key

STOP

The selectable printout forms are:

Simultaneous — All ECG leads are printed in the same time segment (in automatic mode only).

Sequential — Each group is a contiguous time segment of approximately 2.5 or 5 seconds (in automatic mode only).

Auto-Centering ON — All ECG traces are centred dynamically for optimal use of paper width.

Auto-Centering OFF — ECG traces are set to a fixed baseline position and may possibly overlap.

The Standard and Cabrera lead groups available for the AT-2*plus* are:

Lead Groups							
Standard				*Cabrera*			
I	V1	II	V4	aVL	V1	II	V4
II	V2	aVF	V5	I	V2	aVF	V5
III	V3	III	V6	-aVR	V3	III	V6
aVR	V4	V2	V7	II	V4	V2	V7
aVL	V5	V4	V8	aVF	V5	V4	V8
aVF	V6	V5	V9	III	V6	V5	V9

Note: *If the unit is reset to the default settings (see previous page), the user identification must be re-entered*

Settings (cont.)

Acoustic QRS Indication

The acoustic QRS beep can be switched on or off at any time by pressing the QRS key

Time / Date

The required settings can be selected as follows:

Setting the Time and Date						
	Key Sequence				*Enter Data*	*Confirmation*
Time	ALT	9	1	1	HHMMSS	beep
Date	ALT	9	2	2	DDMMYY	beep

Seasonal Time Variation				
Time Change	*Key Sequence*			
Wintertime to Summertime (+1Hr)	ALT	9	4	4
Summertime to Wintertime (-1Hr)	ALT	9	5	5

Automatic Mode (ECG) Settings

Two separate Auto formats can be defined for the AT-2*plus*. When defining auto format 1 the key sequence ALT `1` precedes the setting. When defining auto format 2 the key sequence ALT `2` precedes the setting.

Automatic ECG Format		
Entry Key Sequence		*Setup Format*
ALT	1	Commence Setup for Auto format 1
	2	Commence Setup for Auto format 2

The automatic mode formats are detailed on the following pages. The ECG format is set as follows:

ECG Format					
Entry Key Sequence				*Printout*	*Confirm*
ALT	1 or 2	1	1	1page x 12 leads at 25mm/s	Press STOP key
			2	One page with the first 8 leads printed for 5s and the last 4 leads printed for 10s	
			5	No leads printed	
			6	Leads are printed in short form (1 sheet)	
			7	Leads are printed in long form (2 sheets)	
			8	Chart Speed 25mm/s	
			9	Chart Speed 50mm/s	
			0	Leads are printed in format 4 * 3(25mm/s) + 1 rhythm(25mm/s)	

Automatic Mode (ECG) Settings (cont.)

Average Cycles

The Average cycles are defined as follows:

Note: Lead selection for the rhythm lead(s) are defined on page 25.

Average Cycles (interpretation option only)					
Entry Key Sequence				*Printout*	*Confirm*
ALT	1 or 2	2	5	No average lead cycles are printed	Press STOP key
			6	4 x 3 (25 mm/s) + 2 rhythm leads (25mm/s). The average complexes are printed in 4 groups of three leads at a chart speed of 25mm/s	
			7	4 x 3 (50 mm/s) + 2 rhythm leads (25mm/s). The average complexes are printed in 4 groups of three leads at a chart speed of 50mm/s	
			8	2 x 6 (50 mm/s) + 2 rhythm leads (25mm/s). The average complexes are printed in 2 groups of six leads at a chart speed of 50mm/s	

Measurements and Markings (C version only)

To define the measurements and markings proceed as follows:

Measurements and Markings (interpretation option only)					
Entry Key Sequence				*Printout*	*Confirm*
ALT	1 or 2	3	5	Detailed table of measurement results omitted - however, the values of electrical axes, intervals, and heart rate are not suppressed	Press STOP key
			6	Detailed table of measurement results is printed	
			7	Referenece markings are omitted	
			8	Reference markings (beginning and end of P wave and QRS, and end of T wave) are added to the ECG average cycles	

Automatic Mode (ECG) Settings (cont.)

Interpretation (C version only)

To print or suppress interpretation statements on the printout proceed as follows:

Interpretation (Interpretation Option Only)					
Entry Key Sequence				*Printout*	*Confirm*
ALT	1 or 2	4	5	Interpretation is omitted	Press STOP key
			6	Interpretation is printed	

Confirm the selection by pressing the STOP key

STOP

Full details of the interpretation option are given in the SCHILLER ECG Measurement and Interpretation booklet (Art. No. 2.510 179).

Interpretation Settings (C version only)

The interpretation settings enable the user to determine whether or not certain comments will be added to the interpretation statements on the ECG printout. Furthermore, the patient's age can be defined (<30 or >30) and if low or high sensitivity should be applied. Low sensitivity will suppress certain nonspecific ECG diagnosis; this may be advisable when carrying out ECGs for screening.

Interpretation Settings				
Entry Key Sequence			*Setting*	*Confirm*
ALT	6	1	"Normal" / "Abnormal" is not printed	Press STOP key
		2	"Normal" / "Abnormal" is printed	
		3	"Unconfirmed report" is not printed	
		4	"Unconfirmed report" is printed	
		5	Patient age assummed to be < 30	
		6	Patient age assummed to be > 30	
		7	Low sensitivity	
		8	High sensitivity	

Note: The `Patient age assumed to be..` setting is only applicable when patient data has not been entered.

Automatic Mode (ECG) Settings (cont.)

Selecting Rhythm Leads

The rhythm leads are printed out as defined. Two separate rhythm leads can be selected. The following formats can be set:

Rhythm Leads		
Entry Key Sequence		*Setup Format*
ALT	3	Define Rhythm lead one
	4	Define Rhythm lead two

The 2 rhythm leads are defined as follows:

Extremity Leads					
Entry Key Sequence				*Lead*	*COnfirm*
ALT	3 or 4	8	1	I	Press STOP key
			2	II	
			3	III	
			4	aVR	
			5	aVL	
			6	aVF	

Precordial Leads					
Entry Key Sequence				*Lead*	*Confirm*
ALT	3 or 4	9	1	V1	Press STOP key
			2	V2	
			3	V3	
			4	V4	
			5	V5	
			6	V6	

Confirm the selection by pressing the STOP key

STOP

Memory and Data Transmission Option

WARNINGS & CAUTIONS

WHEN NON-MEDICAL DEVICES ARE CONNECTED TO THE RS-232 INTERFACE ENSURE THAT BOTH UNITS ARE SECURELY CONNECTED TO THE SAME EARTH POTENTIAL.

WHEN OPERATING THE UNIT ON BATTERY AND SIMULTANEOUSLY USING NON-MEDICAL DEVICES, THE RS-232 INTERFACE MUST BE FULLY ISOLATED.

AN EXTERNAL DEVICE MUST ONLY BE CONNECTED USING THE ORIGINAL SCHLLER INTERFACE CABLE ASSEMBLY.

The memory option allows approximately 45 recordings (dependent on size and parameters specified when the recording was taken) to be stored and transmitted over the RS-232 interface. When no more recordings can be stored the message `MEMORY FULL` is displayed. Old recordings must be deleted or transmitted before further recordings can be stored. A number of memory settings can be made as follows:

Note: At the time of print it is not possible to read or to delete individual stored recordings.

Auto Storage and Auto Erase

Memory Setup				
Entry Key Sequence				*Save Mode*
ALT	0	5	0	Auto save off
			1	Auto save on
			2	Auto erase off
			3	Auto erase on

With `auto save on`, all *auto* mode recordings, will be automatically stored on completion.

With `auto erase on`, all stored recordings are erased after sending over the RS-232 interface.

Manual Storage

When auto save is set to off, the following message is displayed after an *auto* mode ECG.

STORE CURRENT RECORDING ?
YES / NO

Use the arrow keys to select yes or no and press the enter key

ENTER

When YES is selected the message `STORING` appears in the message box (under the date and time box), during the storage process.

To store the current recording at any time, press the ALT key followed by the key `S`.

ALT - S

Displaying Memory Files

To display the contents of the memory press the ALT key followed by the key `M `

ALT - M

Memory and Data Transmission Option (cont.)

Erasing Memory Files

To erase the contents of the memory (delete all files) when the memory files are displayed, press and hold the ALT key and press the key `E `

ALT + E

ERASE ALL ? YES / NO

When YES is selected the message `ERASING` appears in the message box (under the date and time box), during the erasing process.

Transmitting Stored Files

The contents of the memory can be transmitted to the SEMA-200 data management program, either directly using the RS-232 connector of the computer, or over the telephone system. Sending directly is termed LINE transmission; sending over the telephone system requires a modem and this form of sending is termed MODEM.

Transmission Settings

The speed settings options for the AT-2plus are as follows:

Serial Communication Interface					
Entry Key Sequence					*Transmission Speed*
ALT	0	9	1	0	115200
				1	57600
				2	38400
				3	28800
				4	19200
				5	14400
				6	9600

The mode of transmission is as follows:

Communication Mode					
Entry Key Sequence					*Mode*
ALT	0	9	2	1	line
				2	modem

Enter the telephone number as follows:

Enter Telephone Number					
Entry Key Sequence					*Mode*
ALT	0	9	3	2	enter number

Note: The modem initialisation commands, entered when the modem is first connected, are also entered in this screen.

Memory and Data Transmission Option (cont.)

Modem Transmission (RS-232 with external modem / or / future Modem option)

To transmit over the telephone network proceed as follows

- Set Communication mode to MODEM - key sequence:

  ALT - 0 - 9 - 2 - 2

- Enter Phone number - key sequence:

  ALT - 0 - 9 - 3 - 2

  the following is displayed:

Phone No. T, 0417608787 Modem Initialization ATB0L1V0Q0E0S0=0

- Enter the telephone number preceded by `P` or `T` (tone or pulse).

  A comma `,` gives a one second pause in dialing - this may be necessary if for example a outside line is required.

- Enter the modem initialisation codes. Full details will be found in the user guide for your modem. However, the modem initialisation must contain at the minimum, the following commands with the prefix `AT`.

  `Q0`- modem sends response
  `V0`- numerical response codes
  `E0`- no command echo

  The standard modem initialisation code is: ATB0L1V0Q0E0S0=0

- Press the patient key to store settings.
- Connect the modem cable assembly (supplied with modem) between the RS-232 connector on the AT-2plus and the modem
- Ensure that the SEMA communication program (SEMACOMM) is active on the computer (see SEMA handbook).
- Enter the memory menue by pressing the ALT key and then press key `M`:

  ALT - M

- Press and hold the ALT key and then press key `T `:

  ALT + T

  The message `TRANSMITTING` appears while the unit is sending in the message box (under the date and time box)

  If a transmission error occurs the message `Tx ERROR` is displayed.

- Check all settings in the SEMACOMM program (baud rate; parity - none; stop bit - 2; time between blocks, records - 100ms).
- Check that the transmission speed is the same in both the AT-2plus and the SEMACOMM program.
- To stop transmission press and hold the ALT key and then press key `Q`.

  ALT + Q

Memory and Data Transmission Option (cont.)

Line Transmission

To transmit directly over line do the following

- Set Communication mode to LINE - key sequence:

ALT - 0 - 9 - 2 - 1

- Connect the cable assembly (optional accessory, art. No. 2.310 159) between the RS-232 connector on the AT-2plus and the COM interface of your Computer.
- Ensure that the SEMA communication program (SEMACOMM) is active on the computer (see SEMA handbook).
- Enter the Memory menue by pressing the ALT key followed by the key `M` :

ALT - M

- Press and hold the ALT key and then press T.

ALT + T

The message `TRANSMITTING` appears while the unit is sending in the message box (under the date and time box)

If a transmission error occurs the message `Tx ERROR` is displayed.

- Check all settings in the SEMACOMM program (baud rate; parity - none; stop bit - 2; time between blocks, records - 100ms).
- Check that the transmission speed is the same in both the AT-2plus and the SEMACOMM program.
- To stop transmission press and hold the ALT key and then press key `Q`.

ALT + Q

Software Updating via RS-232

The AT-2*plus Memory* software can be updated by using a PC program called "SWUP".

Note ! This is only possible with the AT-2plus Memory with software version higher than V 2.11 ! The SWUP programme needs to be reinstalled for each new software.

Prerequisites

- RS-232 cable assembly P/N 2.310 159
- SWUP Programme for Win 95 (2 disks or Zip-file from Mailbox)

Procedure

1. Connect the AT-2plus Memory with the RS-232 cable to any free COM port on your PC
2. Switch the PC ON and go to Win 95.
3. Install the SWUP programme by using "Install.exe" on diskette No.1.
4. Follow the instructions given by the programme.
5. Access the programme through the icon "SWUP". (Schiller-Menu)
6. Go to the configuration menu and chose the applicable COM port (1 or 2).
7. Set the Baudrate to "Auto".
8. Make sure that the AT-2plus is switched ON.
9. Chose "Start 0", "Start 1" or "Start 2".
10. "Start 0" loads the software with languages GER, ENG, FRE, SWE and USA in the AT-2plus Memory.
11. "Start 1" loads the software with languages ITA, SPA, and POR in the AT-2plus Memory.
12. "Start 2" loads the software with language RUS in the AT-2plus Memory (from version V 2.20). Russian interpretation must be set by setting Russian language with ALT - 0 - 2 - 9.

Care & Maintenance

Self-test

Initiate a self-test of the AT-2*plus* as follows:

Self Test				
Entry Key Sequence				*Action*
ALT	0	3	0..6	Service Data Displayed
ALT	0	3	8	Version number
ALT	0	3	9	Screen Test

A table giving information for the service staff is displayed. To obtain a printout press `P` when the table is displayed. Exit this screen by pressing the ENTER key.

12 Monthly Check

The unit should undergo a technical safety check every 12 months. This safety check should include the following:

- Visual inspection of the unit and cables.
- Electrical safety tests according to IEC 601-1 and IEC 601-2-25.
- Functional tests according to the Service Handbook.

The test results must be documented.

Cleaning the Casing

CAUTION

SWITCH THE UNIT OFF BEFORE CLEANING AND DISCONNECT THE MAINS. DO NOT, UNDER ANY CIRCUMSTANCES, IMMERSE THE APPARATUS INTO A CLEANING LIQUID OR STERILIZE WITH HOT WATER, STEAM, OR AIR.

The casing of the AT-2*plus* can be cleaned with a soft damp cloth on the surface only. Where necessary a domestic non-caustic cleaner can be used for grease and finger marks.

Care & Maintenance (cont.)

Cleaning the Patient Cable

Align the leads in such a way as to prevent anyone stumbling over them or any damage caused by the wheels of instrument trolleys.

The patient cable should not be exposed to excessive mechanical stress. Whenever disconnecting the leads, hold the plugs and not the cables. Store the leads in such a way as to prevent anyone stumbling over them or any damage being caused by the wheels of instrument trolleys.

The cable can be wiped with soapy water. Sterilization, if required, should be done with gas only and not with steam. To disinfect, wipe the cable with hospital standard disinfectant.

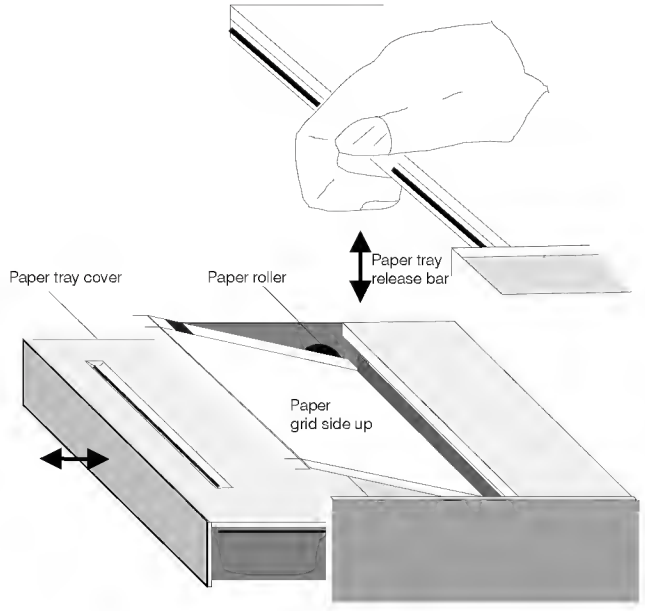
Cleaning the Thermal Print Head

If the printer is used a lot, a residue of printers ink (from the grid on the paper) can build up on the print head. This can cause the print quality to deteriorate. We recommend therefore that every month the print head is cleansed with alcohol as follows:

Remove the paper tray. The thermal printhead is found under the paper tray release catch. With a tissue dampened in alcohol, gently rub the printhead to remove the ink residue. If the printhead is badly soiled, the colour of the paper grid ink (i.e. red or green) will show on the tissue.

Replacing the Recording Paper

The recording paper must be replaced as soon as the end of the paper is indicated by a red stripe on the lower edge. After the indication first appears, there are about 8 pages left. However, we recommend that the paper be replaced immediately. If no paper is left, the printing process is interrupted and a warning is given on the screen. To replace the paper proceed as follows:



- Place fingers under the retaining bar and pull directly upwards. The paper tray cover releases.
- Withdraw the cover from the unit. DO NOT FORCE, THE PAPER TRAY COVER RUNS FREELY OVER THE DEDICATED RUNNERS.
- Remove any remaining paper from the paper tray.
- Place a new paper pack into the paper tray with the printed (grid) side facing upwards.
- Place the beginning of the paper over the black paper roller on the paper tray cover.
- Return the paper tray cover in position and press firmly until secure.
- Press the STOP key to transport the paper to the start position.

Note: *SCHILLER can only guarantee perfect printouts when SCHILLER original chart paper or chart paper of the same quality is used.*

Thermal Paper Handling

The thermal paper used in the AT-2plus requires slightly different handling to normal paper as it can react with chemicals and to heat. However, when the following points are remembered, the paper will give reliable results:

The following points apply to both storage, and when archiving the results.

1. Before use, keep the paper in its original cardboard cover. Do not remove the cardboard cover until the paper is to be used.
2. Store in a cool, dark and dry area.
3. Do not store near chemicals e.g. sterilisation liquids.
4. In particular do not store in a plastic cover.
5. Certain glues can react with the paper - do not attach the printout onto a mounting sheet with glue.

Chapter 2
Functional Overview

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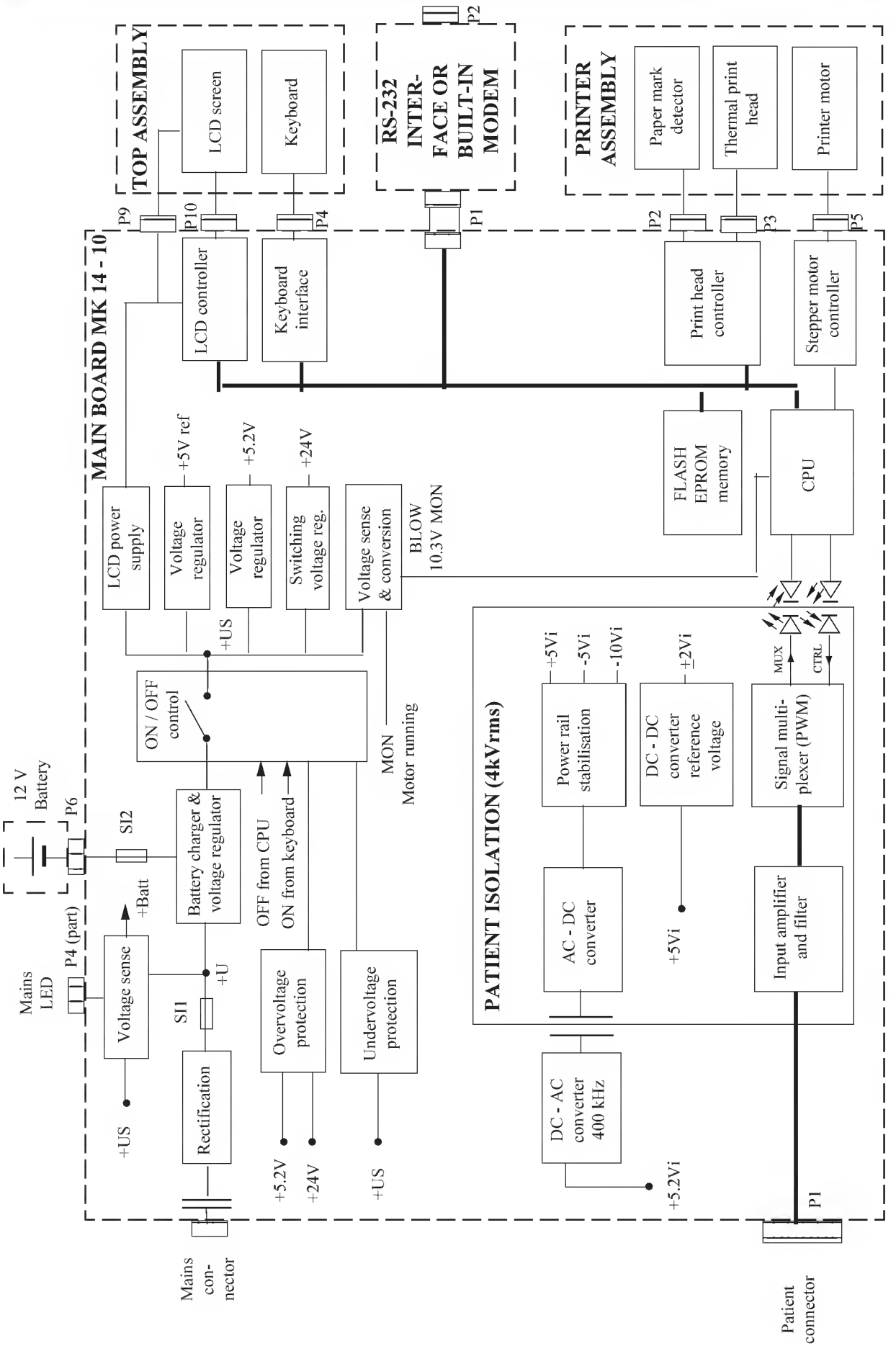
Introduction

This chapter provides a functional overview of the AT-2plus electronics. The aim of this overview is to enable the service engineer to identify processing paths in order to help identify possible faulty modules. A functional block diagram supports the text.

The AT-2*plus Memory* has the following new features compared to the standard version :

- New CPU, 68332
- FLASH EPROM (electrically erasable) 4 Megabytes
- Interface connection
  - RS-232 serial interface
  - Built-in modem interface
    / telephone connection RJ-11
    (future option available in 1998)


TOP ASSEMBLY
LCD screen
Keyboard
RS-232 INTER-FACE OR BUILT-IN MODEM
P2
PRINTER ASSEMBLY
Paper mark detector
Thermal print head
Printer motor
P9
P10
P4
P1
P2
P3
P5
MAIN BOARD MK 14 - 10
LCD controller
Keyboard interface
Print head controller
Stepper motor controller
FLASH EPROM memory
CPU
LCD power supply
Voltage regulator
Voltage regulator
Switching voltage reg.
Voltage sense & conversion
+5V ref
+5.2V
+24V
BLOW 10.3V MON
+US
ON / OFF control
MON Motor running
12 V Battery
P6
SI2
Battery charger & voltage regulator
+Batt
OFF from CPU
ON from keyboard
Mains LED
P4 (part)
Voltage sense
SI1
+U
Overvoltage protection
Undervoltage protection
PATIENT ISOLATION (4kVrms)
+5Vi
-5Vi
-10Vi
±2Vi
MUX
CTRL
Power rail stabilisation
DC - DC converter reference voltage
Signal multi-plexer (PWM)
AC - DC converter
+5Vi
Input amplifier and filter
+US
Rectification
+5.2V
+24V
+US
DC - AC converter 400 kHz
+5.2Vi
P1
Mains con-nector
Patient connector

MK 14 - 10 Main Board

Power Supply

The mains supply is full wave rectified to produce an unregulated dc supply of approximately 30 V (+U). This voltage is used by a switched voltage generator to produce +UD (13.5V). +UD charges the battery when mains is connected. When mains is not connected, +UD is the battery voltage.

An ON/OFF control logic switches +UD to three voltage regulators. The unit is switched on directly from the keyboard and then held on from the CPU . Detection of overvoltage on either the 5.2 V or 24 V supplies directly switches the unit off. Similarly when an undervoltage is detected on +US (indicating overcurrent) the unit is directly switched off.

The mains LED is lit directly when mains is connected. The same circuit also monitors the switched dc supply (+US) and activates signal +BATT when the unit is switched on and mains is not connected (i.e. the unit is running on battery power).

A Battery low signal (BLOW) is set to logic 0 when battery voltage (+US) falls to 11.3 V. A circuit compensates for voltage drop when the printer stepper motor is active and the BLOW signal is active only at 10.3 V.

Note : The battery voltage is also monitored directly by the CPU which switches the unit off when the voltage falls below approximately 9.4 V.

Program and ECG Memory

A FLASH EPROM (electrically erasable) with a capacity of 4 MByte contains the unit software (512 kByte) and the stored ECG data. The two memory blocks can be independently erased. It is possible to update the software via the RS-232 serial interface. This can only be done by a service engineer. Procedure outlined in Chapter 1.

Serial EEPROM

The serial EEPROM (U48) stores the unit base settings.

Thermal Print Head Controller

The Thermal Print Head is controlled by a print head controller and a CPU timer circuit. The print head controller serialises the data for the print head and the timer circuit controls how long current is applied to the head, and thus the intensity of the printout.

Printer Timing

Strobe generation is controlled by the CPU when one complete pixel line of data is ready to be written. Pulse length of STRB1 and STRB2 (each of which controls half of the pixel array) depends from TPH temperature and so form the pulse width of the TPHT signal.

Note: TPH temperature reading is described in Chapter 5.

Paper Mark

The pulsed paper mark signal from the printer is fed to a comparator. A detected papermark supresses any (logic 0) pulses of PMARK at the output of comparator U42.

MK 14-10 Main Board (cont.)

Power On Reset

The Power on reset circuit controls the master reset of the CPU. This circuit has two functions as follows:

- To provide a delay on initial switch-on to ensure that the power supply is fully stabilized and give the 200ms reset time required by the 68332 processor.
- To disable the unit if the +5V rail drops below +4.75V.

Stepper Motor Controller

The printer stepper motor controller sets the speed of the printer motor with a clock frequency dictated by the master CPU.

The purpose of the stepper motor controller circuit is to ensure that the motor speed requested by the microprocessor is achieved and maintained.

ECG Isolated Power Supplies

DC/DC converter circuits produce all the isolated power voltages required by the ECG Amplifier circuit.

The -2.0Vi and the 2Vi isolated reference voltages are generated from the -5Vi supply.

Note: When taking measurements always ensure that the isolated ground is used for reference.

ECG Signal

The incoming ECG signals RA, LA, and C1 to C6 are low-pass filtered (approximately 10kHz) and applied to non-inverting operational-amplifiers giving a gain of 11. The signals are further low pass filtered (approximately 400Hz) and amplified by 23 before being applied to the multiplexer.

The multiplexer sampling rate is 1000Hz.

Noise Damping

The right leg electrode to the patient is the signal ground reference signal. To assist in cancelling some patient noise and thus reducing incoming signal distortion, the incoming signal from the patient left leg electrode is phase shifted 180°. This phase shifted signal is then used by the signal ground reference to cancel (or reduce) patient induced noise.

MK 14-11 RS-232 Interface Board

This is a standard RS-232 / V.24 interface board connected to the MK 14-10 main board. The communications controller contains a USART and interface circuit which performs the parallell / serial and serial / parallell conversion for the transmission and reception of data and provide signal level compatibility with RS-232 standard.

External Modem

An external modem can be connected to the RS-232 output from the AT-2plus and be used for transmitting memory contents over a telephone line.

MK 14-12 Modem Interface Board

Future versions of the AT-2plus Memory will include a modem interface board in place of the RS-232 board. The outgoing data are converted from parallell to serial form and then modulated for transmission over a telephone line. The incoming data are first demodulated and then converted from serial to parallell form.

Top Assembly

LCD Screen

The LCD power supply produces the high voltage for the LCD backlight and the contrast voltage. The ECG signals are stored in a video RAM and the LCD controller converts the data to the proper form for the LCD screen.

Alphanumerical Keyboard

The keyboard is a matrix style circuit which is periodically scanned by the processor via the keyboard interface circuit. It is an integral part of the top assembly and can not be individually replaced.

Chapter 3
Fault Diagnosis

Contents

Introduction *3.2*

General Check Procedures *3.3*

Printer Check *3.4*

Print Head Alignment and Print Head Tension *3.4*

RS-232 Test with Test Plug *3.5*

Memory and Data Transmission Check *3.6*

Introduction

The AT-2plus is designed to be simple to use and simple to service: the service philosophy of the AT-2plus is module replacement and not board repair. The purpose of this chapter is to provide fault-finding procedures that will quickly and efficiently identify a fault to a specific module. Fault-finding procedures are designed so that test equipment is kept to a minimum.

The AT-2plus contains the following modules:

- MK 14-10 Main Board including main and LCD power supplies
- RS-232 Interface board (or Modem Interface board)
- LCD screen assembly
- Alphanumerical keyboard (integral part of the top assembly)
- Printer assembly

An initial fault-finding table is provided detailing general fault indications. Use the procedures on the following pages to indicate a faulty area or module. In most cases the fault finding tables should indicate the most likely faulty area. When more than one module is stated, the first module given is the one most likely to contain the fault. Other modules given should be checked in the order given. When a module has been replaced specific test parameters and setting-up of the module may be applicable. The removal and replacement instructions for all replaceable modules, along with any setup or check procedures required, are given in Chapters 4 and 5.

If the initial fault-finding table does not indicate the area where the fault exists, re-check all the settings and parameters that have been entered. If these are correct, check the software.

General Check Procedures

The procedure detailed here is a general confidence check of the unit after an internal module or board has been replaced. It is not a full functional test (which can only be carried out with dedicated equipment in the factory) but is intended to provide a general confidence check in all the major AT-2plus functional areas. The instructions given here are guides to the basic functions. If more operating information is required (general settings, comprehensive menu guides etc.) please refer to Chapter 1 in this publication or the relevant User Manual for the software version applicable.

Test Procedure	***Result***	***Corrective action if result not OK***
Connect unit to mains supply.	Mains indicator (LED) is lit.	Check mains fuse on the back panel and replace if necessary. If problem remains, replace main board MK 14-10.
Switch the unit on by pressing the ON key on the keyboard.	If no ECG simulator is connected, a short audible alarm is generated and the lead indications in the display are flashing..	Ignore or connect ECG simulator
	LCD screen comes on and shows three ECG traces and a number of status indications.	Check power board, ECG and main board.
	ECG traces are barely visible	Open the unit and check that the two wire connection from the power supply to the LCD assembly is properly connected (high-voltage backlight). If problem remains, replace LCD assembly.
	No traces visible on the LCD screen.	Check that the signal cable from the main board to the LCD assembly is properly connected. If problem remains, check LCD assembly, power, ECG and main board.
Connect an ECG simulator to the ECG connector on the side panel and switch ON.	Three ECG traces, heart rate, sensitivity, time scale and status of lead connections are shown on the screen.	If a lead alarm is flashing, check that the lead is properly connected
Press the MAN Start key.	Six leads are printed and are of good quality.	If not, reset to default settings and try again. Open the case and inspect all cable assemblies and connectors. Check printer alignment. Run printer test (see next page). Check / replace printer motor. Replace main board MK 14-10. Replace paper tray and complete printer assembly.
Press AUTO START and wait approximately 10 seconds for the printout to commence.	A preprogrammed printout is produced.	If not as programmed, check all settings. If problem remains, replace main board MK 14-10.
Switch the unit OFF and leave connected to the mains supply for 10 hours or more to charge the battery.		
Disconnect the mains and switch the unit ON.	Battery symbol is shown on the LCD screen.	
Run the unit on battery power for approximately an hour.	Unit fully operational. No degradation.	If not, check battery and replace if necessary.
Run the unit more than 8 hours on battery power (AT-2plus Memory 4 hours).	Battery symbol flashes.	

Printer problems - see next page.

Printer Check

To check the printer and to ensure that every pixel is operational, a built-in printer test is provided. To carry out the printer check press:

ALT - MAN START

A test printout is given. Four test patterns are available - toggle between the test patterns with the lead arrow keys up or down.

Carefully examine the printout and ensure that all the lines are even and uninterrupted. Any faulty print-head pixels will be seen as a horizontal white line. Examine the printout for evenness of print.

If a faulty pixel is detected the printer must be replaced. If the printout is uneven (for example darker at the top than at the bottom), it indicates that the printer alignment is not correct. If the printout is too faint or too dark, check the TPH temperature in the self test printout given in Chapter 5. Also check the paper; old paper, paper that has been exposed to light for a long period, or poor quality paper can all adversely effect the print quality.

NOTE: *THE ‚SHELF LIFE' OF THE PRINTER PAPER IS NOT INDEFINITE. OLD PAPER, PAPER THAT HAS NOT BEEN STORED IN A COOL DAMP FREE ENVIRONMENT, OR PAPER THAT HAS BEEN EXPOSED TO EXCESSIVE HEAT CAN ADVERSELY EFFECT THE QUALITY OF THE PRINT*

Print Head Alignment and Print Head Tension

The print head tension (the pressure that the print head exerts on the printer paper) is achieved with two spring exerting pressure on the print head: the print head tension cannot be adjusted. Similarly print head alignment is fixed and cannot be adjusted. If the print head tension or print head alignment is not correct change the paper tray and printer assembly.

Possible Printer Problem	***Corrective Action***
Paper jams or does not stop at correct position.	Clean paper mark detector with a 70% alcohol solution. Allow to dry completely. Ensure that good quality, fresh paper is installed. Change the Printer Motor driver board.
Printout uneven; Fading at top or bottom.	Check evenness of spring pressure of the printer to roller. Check roller for wear and symetry. Clean print head (pixel array) with alcohol. Ensure that good quality, fresh paper is installed.
Faulty pixel.	Clean print head (pixel array) with alcohol. Replace printer.
Printout too faint or too dark; General quality poor.	Carry out the strobe timing adjustment detailed in Chapter 5. Clean print head (pixel array) with alcohol. Ensure that good quality fresh paper is installed.

RS-232 Test with Test Plug

The communication circuits on the RS-232 interface board can be checked by transmitting a signal and sending the signal ditectly back to the unit via the test plug. To carry out this test proceed as follows:

Note: If the SCHILLER test plug is not available a test plug can easily be fabricated from a standard 9-pin D-type connector (female). Shortcircuit the following pins:

- pins 2 and 3 (receive / transmit)
- pins 7 and 8 (RTS / CTS)
- pins 6 and 4 (DSR / DTR (ready))

1. Connect the RS-232 test plug (part number to be assigned) to the RS-232 port on the side of the unit.
2. Switch the unit ON.
3. Select communication test by entering :

ALT - 0 - 3 - 7

4. Press the key **R** (receive). No output on the screen.
5. Press the key **T**. A string of characters are transmitted and will be visible on the screen.
6. You can also press **S,** whereby one single character (U) is sent over the test plug.
7. Press **Q** to quit the test and the patient key to return to ECG display.

Memory and Data Transmission Check

To perform these tests, the following equipment is needed:

- A personal computer (PC) with the SEMA communication program (SEMACOMM) installed.
- An RS-232 cable assembly, Art.No. 2.310 159 for connecting the RS-232 interface on the AT-2plus with the COM port of the PC.
- A patient simulator attached to the patient connector on the AT-2plus.

Test Procedure	*Command*	*Screen Display*
Display Memory files	ALT - M	Memory ECG list
Erase Memory files	Press and hold ALT and press E	ERASE ALL ? YES / NO
Confirm	Select YES and press ENTER	"ERASING" flashing
Set Auto save ON	ALT - 0 - 5 - 1	
Set Auto erase ON	ALT - 0 - 5 - 3	
Enter patient data	Press data/ECG button	Patient data
Start AUTO mode ECG	Press AUTO button	ECG
Check Memory files	ALT - M	New file in memory
Connect RS-232 cable between AT-2plus and PC		
Check settings SEMA	Config	Baud, n, 2, 100 ms
Set baud rate AT-2plus	ALT - 0 - 9 - x (see Page 1.25)	
Confirm baud rate setting	Press STOP	
Set Line transmission	ALT - 0 - 9 - 2 - 1	
Enter memory menue	ALT - M	Memory file(s) displayed.
Transmit Memory file(s)	Press and hold ALT and press T	"TRANSMITTING" flashing
Stop transmission	Press and hold ALT and press Q	
Check that file has been transferred to PC	Directory Semacomm \ sdrecs	New file present.
Check that file has disappeared in AT-2plus	ALT - M	Memory ECG list empty
Back to measurement mode	Press Data/ECG button	ECG traces

Chapter 4
Module Removal and Replacement

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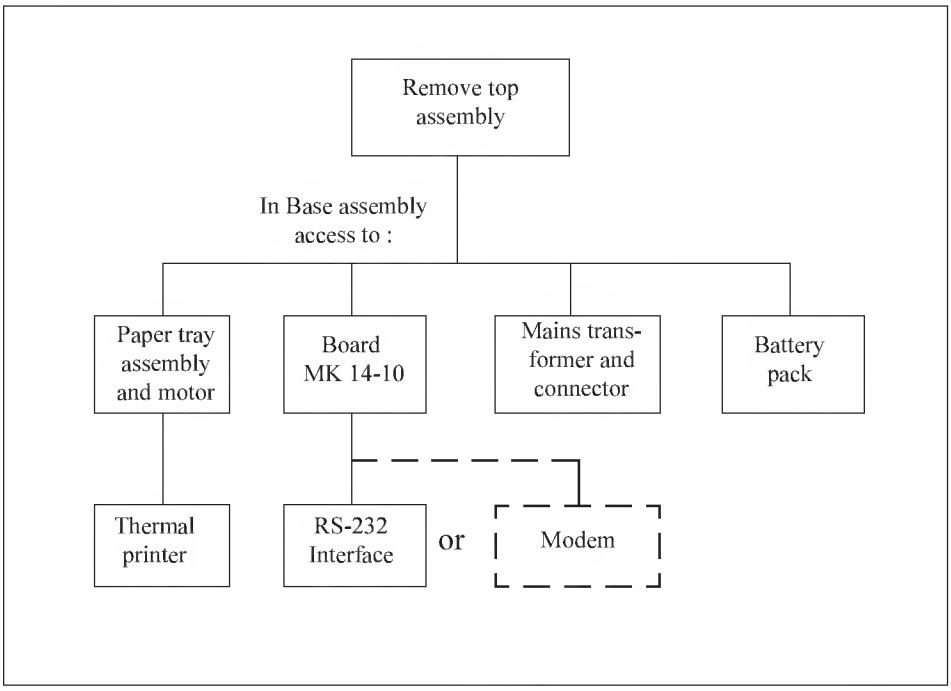
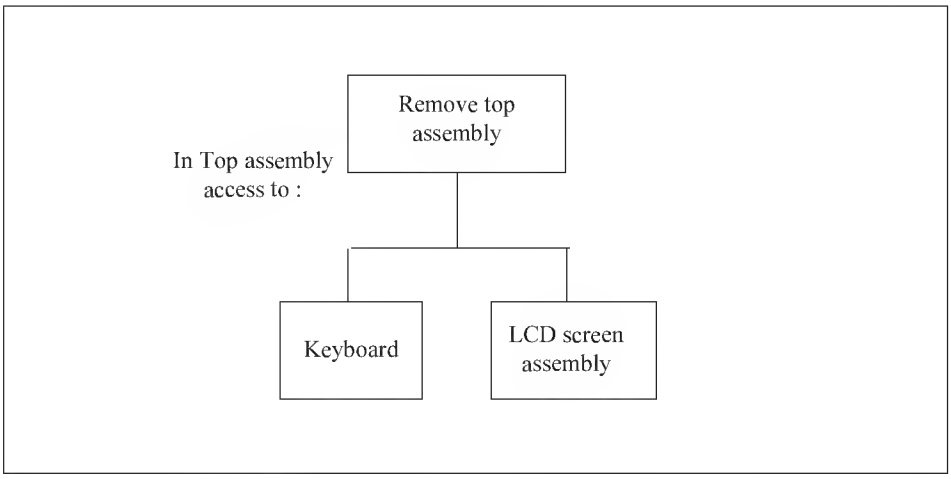

Remove top assembly
In Base assembly access to :
Paper tray assembly and motor
Board MK 14-10
Mains trans-former and connector
Battery pack
Thermal printer
RS-232 Interface
or
Modem


In Top assembly access to :
Remove top assembly
Keyboard
LCD screen assembly

Introduction

This Chapter provides an overview of the procedures to remove and replace the modules that are spared at service level. The instructions given in this chapter are autonomous, with each module containing the following:

- The prerequisites that must be fulfilled before removing of the module
- Tools and equipment that are required to remove and replace the module and to carry out the functional checks and adjustments
- Removal Procedures
- Replacement Procedures
- Checks and Tests that must be carried out after replacement.

Any adjustments, jumper settings, special checks or functional procedures that are required during a procedure, are detailed in the relevant step.

In-text diagrams support the text where required and provide location details of connectors, test points and adjustment potentiometers.

Specific warnings and cautions are given where applicable. Warnings indicate potential danger that could cause personal injury. Cautions indicate areas that could cause damage to the equipment .

If a key operation or menu selection is required, the key sequence required is given in bold letters. The character (or character string) given is the actual character that is printed on the key. When a key sequence is provided it must be followed in the order given.

Safety Notices

WARNINGS

BEFORE COMMENCING ANY REMOVAL OR REPLACEMENT PROCEDURES ENSURE THAT THE MAINS POWER SUPPLY IS SWITCHED OFF AND THAT THE MAINS CABLE IS REMOVED.

CERTAIN CHECKS AND ADJUSTMENTS CAN ONLY BE CARRIED OUT WITH THE TOP ASSEMBLY REMOVED AND WITH MAINS CONNECTED. WHEN CARRYING OUT THESE PROCEDURES BEWARE THAT POTENTIALLY LETHAL VOLTAGES ARE PRESENT.

CAUTIONS

THE AT-2PLUS CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTISTATIC PRECAUTIONS:

WHEN CARRYING OUT ANY MAINTENANCE PROCEDURES ALWAYS PLACE THE UNIT ON AN EARTHED ANTISTATIC MAT.

PERSONNEL MUST BE EARTHED WHEN HANDLING ANY BOARDS OR COMPONENTS

ALWAYS USE AN ANTISTATIC BAG WHEN TRANSPORTING BOARDS OR COMPONENTS

THE UNIT IS SUSCEPTIBLE TO ABRASION DAMAGE. TO PREVENT SCRATCHING, ALWAYS PLACE THE UNIT ON A SOFT, NON-ABRASIVE CLOTH WHEN CARRYING OUT MAINTENANCE PROCEDURES.

TAKE CARE NOT TO PLACE ANY STRAIN ON THE CONNECTING RIBBON CABLE WHEN REMOVING THE TOP ASSEMBLY . ENSURE THAT THE CABLE ASSEMBLY IS NOT CRIMPED OR TWISTED AND THAT THE TOP ASSEMBLY IS NOT PLACED ON THE CABLE ASSEMBLY.

CARE MUST BE TAKEN WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

THE PROCEDURAL STEPS GIVEN FOR EACH MODULE MUST BE FOLLOWED IN THE ORDER GIVEN.

Physical Overview

The AT-2plus unit is enclosed in a two part, medical standard, moulded plastic case.

The top part contains the keyboard and the LCD screen with the base section containing all the electronics of the unit, the RS-232 interface, the thermal printer, the paper tray, the battery and mains transformer.

The electronics of the unit are contained on two printed circuit boards, the main board (MK 14-10) secured on spacers moulded in the base section, and the RS-232 serial interface board (MK 14-11) mounted on spacers in the base assembly.

The battery is secured in position in a moulded recess and the mains transformer is secured on spacers above the printed circuit board.

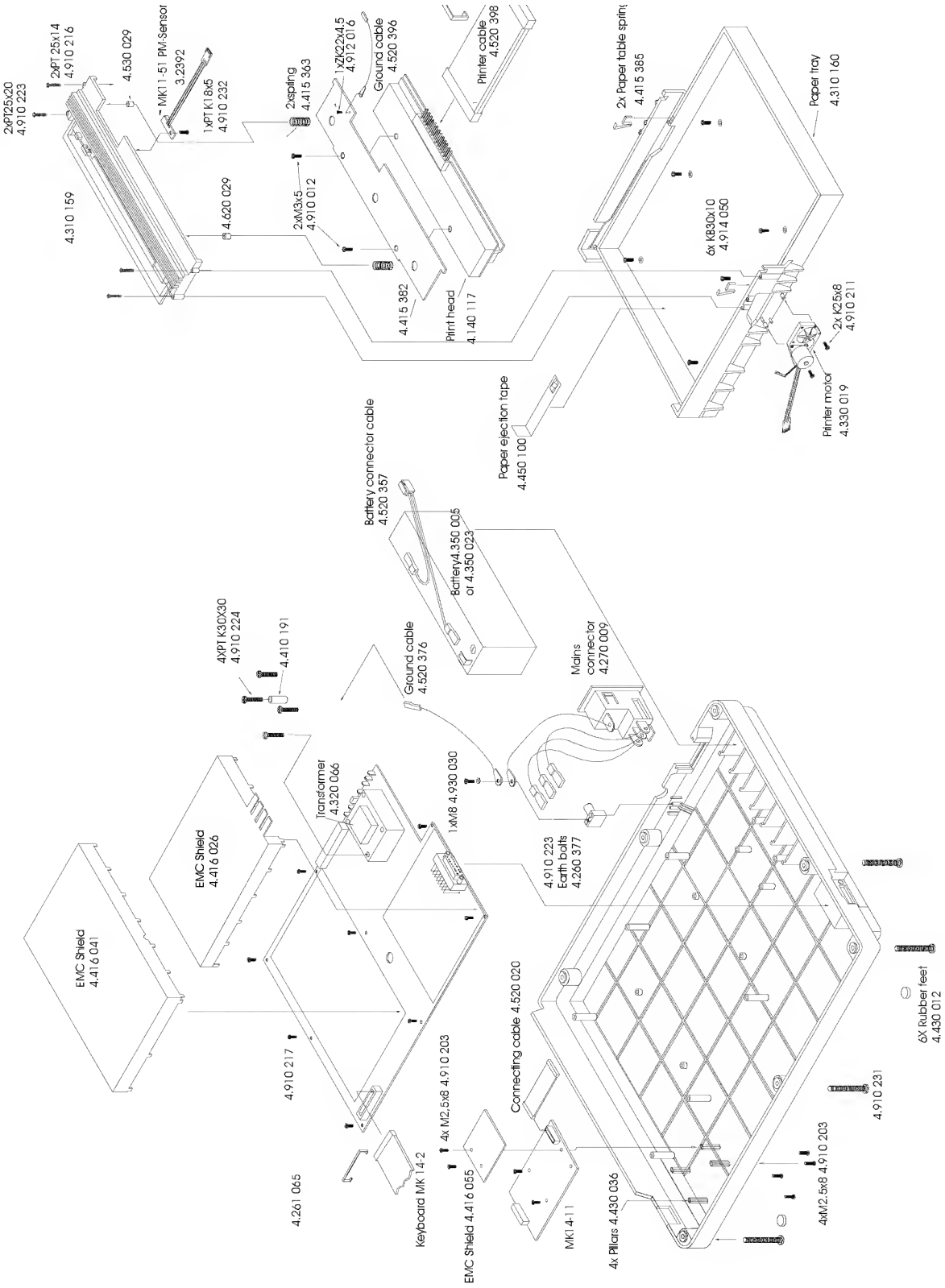
The thermal printer is mounted on a paper tray/thermal printer assembly which is secured in the base section complete.

Test Equipment, Tools, and Accessories

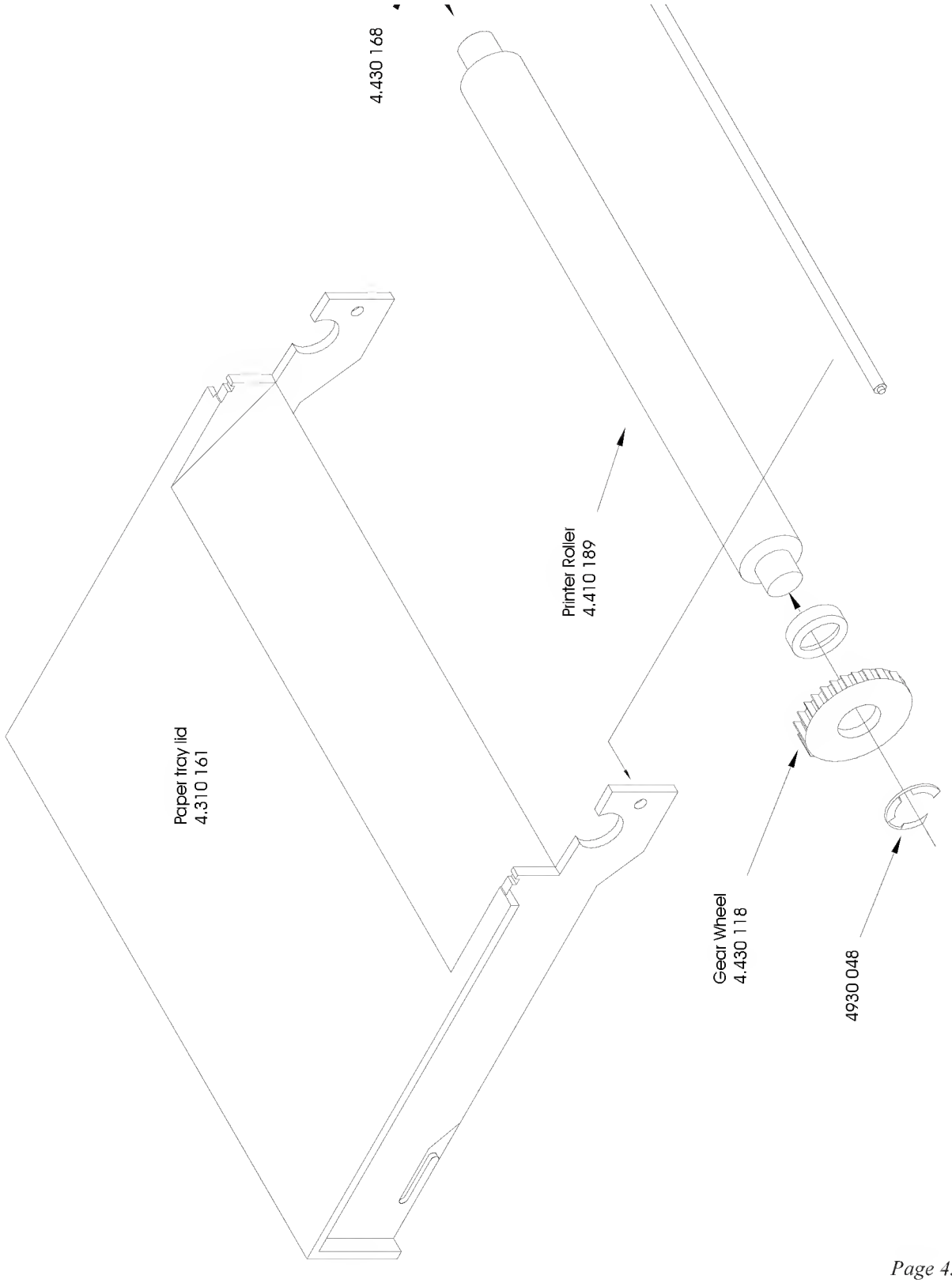
The following list details the tools, test equipment and accessories required to carry out all functional tests, calibration procedures and adjustments that can be carried out on the AT-2plus. The test equipment given here is general. If specific recommendation for test equipment is required, please contact the SCHILLER service department.

- Digital Voltmeter
- Selection of cross-bladed, posi-drive and flat-bladed screwdrivers
- Cleaning agent such as Trichlorethylene
- Selection of spanners
- Double-sided tape
- ECG Patient Simulator

Exploded View Base Assembly and Printer



Exploded View Paper Feed



Opening and Closing the Case

Prerequisites

- The unit must be placed on an antistatic mat and antistatic precautions observed when any maintenance is carried out on the AT-2plus. The room temperature should be between 18 and 28 degrees.
- THE WARNINGS AND CAUTIONS AT THE BEGINNING OF THE CHAPTER MUST BE OBSERVED.

Tools

- Posi-drive screwdriver

Test Equipment

The following test equipment is required to carry out the functional test after unit assembly

- SCHILLER Patient Cable
- Patient Simulator e.g. phantom 320.

Top Assembly Removal

The Top Assembly is mounted on the Base Assembly and is secured to the Base Assembly with seven screws; access to the screws is gained from the underside of the unit. To remove the Top Assembly, proceed as follows

WARNING

ENSURE THAT THE MAINS CABLE IS REMOVED !

1. Turn the unit upsidedown and rest on a soft antistatic cloth.
2. Unscrew and remove the seven countersunk retaining screws and washers situated in the extreme corners and edges of the unit.
4. Grasping the top and bottom of the unit to ensure that the two assemblies cannot part, carefully return the unit to the standing position.
5. Gently lift the Top Assembly sufficiently to gain access to the interconnecting cables. Disconnect the cable assembly between the main board MK 14-I0 and the keyboard and the ribbon and dual-wire cable assemblies between the power supply and the LCD screen board.
6. Gently lift the Top Assembly away from the Base Assembly and place on a soft cloth.

Opening and Closing the Case

Top Assembly Replacement

To replace the Top Assembly proceed as follows:

1. Check that all boards and components are firmly secured. Check for loose screws. Ensure that no screws or foreign bodies are loose in the bottom of the case.
2. Inspect all the internal cable assemblies and ensure that they are in good condition and that no visible damage can be seen. Ensure that no cable assemblies are strained, crushed or caught.
3. Ensure that all connectors are firmly home.
4. Position the Top Assembly in front of the Base Assembly and without straining the ribbon cable, plug in the interconnecting cable from the keyboard to the main board. Connect the ribbon and the dual-wire cable assemblies from the LCD board to the power supply part of the main board.

   Note: It may be necessary to tilt the Top Assembly for the cable assemblies to reach.
5. Carefully position the Top Assembly on the Base Assembly.
6. Grasping the two assemblies to ensure that they cannot part, carefully turn the unit upsidedown and replace the seven securing screws and washers in the extreme corners and edges of the unit. Return the unit to the upright position.
7. Carry out the functional check procedure detailed in Chapter 3.

Printer Tray Assembly and Thermal printer

Prerequisite

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed as detailed previously. All external cable assemblies must be disconnected.

Tools

- Cross-bladed screwdriver
- Flat-bladed screwdriver
- Flat ended pliers

Part Numbers

The part numbers for the Thermal Printer Assembly, the print head and the motor are given in Chapter 6.

CAUTION

THE THERMAL PRINTER CONTENTS IS STATIC SENSITIVE; OBSERVE ANTISTATIC PRECAUTIONS

Printer/Paper tray Assembly Removal

1. Remove the following connectors from the Main board MK 14-10 :
   - data connector to the thermal printer
   - paper mark connector
   - printer motor connecter
   - earth connector
2. Unscrew the six retaining screws and remove the complete paper tray/printer assembly.

Thermal Printer Removal

1. Unscrew the four retaining screws securing the printer in position.

CAUTION

THE PRINTER IS TENSIONED WITH TWO SPRINGS UNDER THE RETAINING BAR. TAKE GREAT CARE WHEN REMOVING THE FOUR SCREWS NOT TO LOOSE THE SPRINGS.

2. Gently remove the printer taking care to retain the two tensioning springs.

Printer Tray Assembly and Thermal printer

Thermal Printer Replacement.

To replace the Thermal Printer proceed as follows:

1. Position the Printer in the paper tray/print assembly so that the printer mounting plate lips slot into the dedicated cutouts in the assembly;
2. Insert the two tensioning springs so that the springs are positioned over the outer two moulded spring supports and in the indent (hole) in the printer mounting plate
3. Position the printer retaining bar and secure the printer and printer retaining bar with the four retaining screws. Ensure that the cable assemblies from the printer to the PCB are not caught and are not strained.

Printer/Paper tray Assembly Replacement

1. Position and secure in the base the assembly with the six retaining screws.
2. Reconnect the following connectors to the main board MK 14-10 :
   - data connector to the thermal printer
   - paper mark connector
   - printer motor connecter
   - earth connector
3. Replace the Top Assembly.

Checks, Tests and Adjustments after Printer Replacement

Check the print quality as described in Chapter 3.

Main Board MK 14 - 10

Prerequisite

- The Warnings and Cautions at the beginning of the chapter must be observed.
- The top assembly must be removed and all external cable assemblies disconnected.
- The printer and printer tray assembly must be removed

Tools and Equipment

Posi-drive screwdriver

Parts

Main board MK 14-10. Part number as detailed in Chapter 6.

Board Removal

WARNING

ENSURE THAT THE MAINS CABLE IS DISCONNECTED BEFORE COMMENCING

1. Disconnect the following connectors:
    - live and the neutral bayonet connectors to the mains connector
    - battery connector
    - connecting cable to RS-232 board MK 14-11 (or Modem board)
2. Unscrew the 12 spacer fixations (four on the mains transformer) and remove the board.

Board Replacement

To replace the Main board MK 14-10 proceed as follows:

1. Position the board and secure at the 12 fixing points (four on the mains transformer)
2. Connect the following:
    - live and the neutral bayonet connectors to the mains connector
    - live and the neutral bayonet connectors to the battery
    - connecting cable to RS-232 board MK 14-11 (or Modem board)
3. Replace the paper tray and printer assembly and reassemble the unit.

Battery Pack

Prerequisite

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.

Parts

The part numbers of all replaceable items are given in Chapter 6.

Battery Pack Removal

WARNING

THE MAINS SUPPLY MUST BE DISCONNECTED DURING THIS PROCEDURE

To remove the Battery Pack proceed as follows:

1. Ensure that the unit is switched off and that the mains is disconnected.
2. Disconnect the two bayonet connectors and remove the Battery Pack by gently pulling away from the base.

Battery Pack Replacement

1. Position the Battery Pack with the connectors towards the outside of the unit.
2. Connect bayonet connectors.

Checks and Tests After Battery Replacement

Program all static settings which will have been lost when the battery was disconnected including date and time.

Set Date:

ALT - 9 - 2 - 2 - D - D - M - M - Y - Y

An acoustic signal confirms the changed setting.

Set Time:

ALT - 9 - 1 - 1 - H - H - M - M - S - S

An acoustic signal confirms the changed setting.

Keyboard

The keyboard comes as a complete assembly with the top casing. The part number of the keyboard is given in Chapter 6.

LCD screen board

Prerequisite

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed as detailed previously. All external cable assemblies must be disconnected.

Tools

- Cross-bladed screwdriver

Part Number

The part number for the LCD screen board is given in Chapter 6.

CAUTION

THE LCD BOARD CONTENT IS STATIC SENSITIVE; OBSERVE ANTISTATIC PRECAUTIONS

LCD board Removal

1. Unscrew the four retaining screws securing the LCD board in position.
2. Remove the board.

LCD board Replacement

To replace the LCD board proceed as follows:

1. Position the board and secure at the 4 fixing points
2. Connect the following:
   - LCD high-voltage backlight (dual-wire) and signal cable assemblies
   - keyboard cable assembly
3. Replace the top assembly as explained earlier in this Chapter.

RS-232 Serial Interface Board MK 14 - 11

Prerequisite

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed as detailed previously. All external cable assemblies must be disconnected.

Tools

- Cross-bladed screwdriver

Part Number

The part number for the RS-232 board is given in Chapter 6.

CAUTION

THE RS-232 BOARD CONTENT IS STATIC SENSITIVE; OBSERVE ANTISTATIC PRECAUTIONS

RS-232 board Removal

1. Disconnect the 10 pole connector to the main board.
2. Unscrew the four retaining screws securing the board in position.
3. Remove the board.

RS-232 board Replacement

To replace the RS-232 board proceed as follows:

1. Position the board and secure at the 4 fixing points.
2. Connect the 10 pole connector to the main board.
3. Reassemble the unit.

Modem Interface Board MK 14 - 12

Prerequisite

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed as detailed previously. All external cable assemblies must be disconnected.

Tools

- Cross-bladed screwdriver

Part Number

The part number for the Modem board is given in Chapter 6.

CAUTION

THE MODEM BOARD CONTENT IS STATIC SENSITIVE; OBSERVE ANTISTATIC PRECAUTIONS

Modem board Removal

1. Disconnect the 10 pole connector to the main board.
2. Unscrew the four retaining screws securing the board in position.
3. Remove the board.

Modem board Replacement

To replace the RS-232 board proceed as follows:

1. Position the board and secure at the 4 fixing points.
2. Connect the 10 pole connector to the main board.
3. Reassemble the unit.

Chapter 5
Adjustments

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Procedure 5.8

ECG Amplifier reference voltage **5.9**

Service Screen **5.10**

Software Options / Updates **5.12**

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Installing Software Updates 5.12

Introduction

This Chapter provides the procedures necessary to check and adjust all service settings. Every procedure is self-contained and details the tools required to carry out adjustments, and the test equipment necessary. Any adjustments, jumper settings, special checks or functional tests that are required on the module, or on associated modules or software, are also detailed.

In-text diagrams support the text where required and provide location details of connectors, test points and adjustment potentiometers.

Specific warnings and cautions are given in the text where applicable.

The part numbers for all replaceable modules are given in Chapter 6.

The AT-2plus has the following adjustments:

- Battery Charge Voltage (VR1 on the main board MK 14-10)
- ECG Amplifier reference voltage and ramp slope (VR2 and VR3 on the main board MK14-10)

We recommend that the reference voltages are checked every year.

Safety Notices and Conditions

WARNING

MAINS POWER IS POTENTIALLY LETHAL - DISCONNECT THE MAINS BEFORE DISASSEMBLING THE UNIT. ADDITIONALLY ENSURE THAT THE MAINS IS DISCONNECTED BEFORE CARRYING OUT ANY MAINTENANCE, CALIBRATION, CHECKS, OR ADJUSTMENTS.

CAUTIONS

THE AT-2PLUS CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTISTATIC PRECAUTIONS. WHEN CARRYING OUT ANY MAINTENANCE PROCEDURES ALWAYS PLACE THE UNIT ON AN EARTHED ANTISTATIC MAT. PERSONNEL MUST BE EARTHED WHEN HANDLING ANY BOARDS OR COMPONENTS. ALWAYS USE AN ANTISTATIC BAG WHEN TRANSPORTING BOARDS OR COMPONENTS

CARE MUST BE TAKEN WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

THE PROCEDURAL STEPS GIVEN FOR EACH MODULE MUST BE FOLLOWED IN THE ORDER GIVEN.

THE OUTER SURFACES OF THE AT-2PLUS ARE SUSCEPTIBLE TO ABRASION DAMAGE. TO PREVENT SCRATCHING, ALWAYS PLACE ON A SOFT, NON-ABRASIVE CLOTH.

Conditions

The unit must be placed on an antistatic mat and antistatic precautions observed when any maintenance is carried out on the AT-2plus.

The room temperature should be between 18 and 28 degrees.

Note: *When a key operation or menu selection is required in the following procedures, the key sequence required is given in bold letters. The character, or character string, given is the actual character, or character string, printed on the key.*

Test Equipment

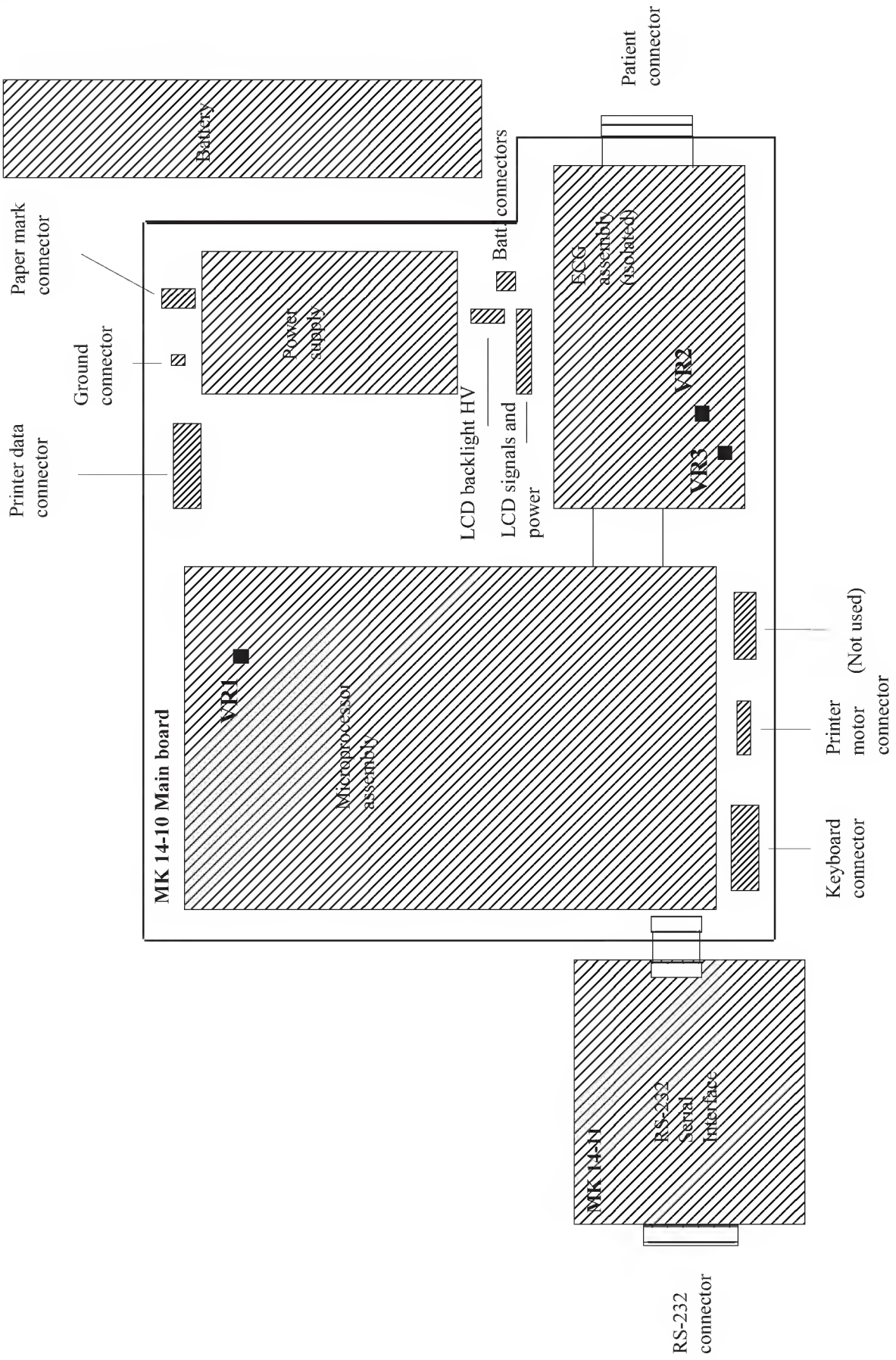
The following proprietary and dedicated test equipment is required to fault find and carry out all board checks and adjustments on the AT-2plus.

The list of proprietary equipment is not comprehensive. Recommendations of suitable proprietary test equipment can be obtained from the SCHILLER Service Department.

Proprietary Test Equipment/Tools

- ECG Simulator, e.g. Phantom 320
- Oscilloscope
- Digital Multimeter
- Standard tool kit with a selection of cross-bladed, flat-bladed and posi-drive screwdrivers, pliers and general tools
- SCHILLER 10 lead patient cable Number 2.400070 (2. 400071 for USA)

Main Board MK 14-10 Adjustment locations



Battery Charge Voltage

Precautions and Requirements

The unit must be placed on an antistatic mat and antistatic precautions observed when any maintenance is carried out on the AT-2plus. The room temperature should be between 18 and 28 degrees.

Tools and Equipment

- Digital voltmeter
- Small flat bladed screwdriver
- Resistor 2.7kOhms, 250mW

Procedure

The battery charge voltage is nominally 13.5V. Adjust and check as follows:

- DISCONNECT THE MAINS SUPPLY

CAUTIONS

THE AT-2PLUS CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTISTATIC PRECAUTIONS . PLACE THE UNIT ON AN EARTHED ANTISTATIC MAT. PERSONNEL MUST BE EARTHED WHEN HANDLING THE UNIT.

EXERCISE CARE WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

- Disassemble the unit as detailed in Chapter 4 and remove Printer and printer tray assembly.
- Remove the Main board MK 14 - 10 from the assembly and remove the EMC shield from the board
- Replace the board in position
- Remove the two battery connectors (if not already removed) and connect a 2.7 kOhm 250mW resistor across the two battery connectors on the main board to simulate a discharged battery. Connect the digital multimeter across the resistor.
- Connect the Mains supply.

WARNING

EXERCISE CARE - BE AWARE THAT POTENTIALLY LETHAL VOLTAGES ARE PRESENT

- Adjust VR1 to obtain a charging voltage of 13.5V.
- Disconnect the mains supply and reassemble the unit as detailed in Chapter 4.

Paper mark Detector Check

Tools, Equipment and Material

- Digital voltmeter
- Small flat bladed screwdriver
- 70% alcohol solution and clean lint free cloth

Procedure

To adjust the paper-mark Schmitt trigger sensitivity proceed as follows:

- DISCONNECT THE MAINS SUPPLY
- Open the paper tray lid and clean the photocell (situated on the opposite side to the dc motor) with a 70% alcohol solution. Allow to completely dry.
- Disassemble the unit as detailed in Chapter 4.
- Reconnect the keyboard to the Control board and place the top assembly on its side in front of the Base assembly .
- Switch the unit on and set the speed of the printer to the slowest setting of 5mm/s (5mm/s key).
- Press the MAN START key to activate the printer. The paper is now moving at low speed (through the roller and paper mark detector).
- Check the pulse amplitude at P8 pin 1. (Measure with AC setting, signal is noisy.)
    - no paper-mark (white paper) between -80mV and -200mV
    - paper mark (black paper) between -5mV and -30mV
- Reassemble the unit as detailed in Chapter 4.

ECG Amplifier +2V, -2V and PWM Ramp Time Adjustment

The ±2V voltage rails generated on the ECG Amplifier board are used as a reference by the measurement and PWM circuits.

Note: The ECG board reference voltage is given on the service printout and can be checked without disassembling the unit. Full details of the service printout are given later in this chapter.

IMPORTANT

THE ±2V REFERENCE VOLTAGES, AND THE PWM RAMP MUST BOTH BE ADJUSTED AT THE SAME TIME.

Tools, Equipment and Material

- Digital voltmeter
- Small flat bladed screwdriver

Procedure

- DISCONNECT THE MAINS SUPPLY

CAUTIONS

THE AT-2PLUS CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTISTATIC PRECAUTIONS . PLACE THE UNIT ON AN EARTHED ANTISTATIC MAT. PERSONNEL MUST BE EARTHED WHEN HANDLING THE UNIT.

EXERCISE CARE WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

- Disassemble the unit as detailed in Chapter 4 and remove Printer and printer tray assembly.
- Remove the Main board MK14-10 from the assembly and remove the EMC shield from the board
- Replace the board in position
- Reconnect the keyboard to the control board and place the top assembly on its side in front of the Base assembly .

ECG Amplifier reference voltage

- Switch the unit on and measure the voltage difference between the +2V reference and the -2V reference on pins 1 and 7 of operational amplifier U5. Adjust trimmer VR2 to achieve a voltage difference of 4000 mV ±2mV.
- Obtain a printout of the test screen by pressing

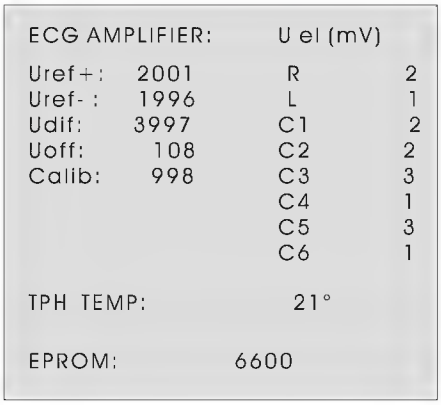
  ALT - 0 - 3 - any number 0...6

  Ensure that the Uref+ and the Uref- measurements are both 2000mV ± 20mV. Ensure that the Udiff reading is 4000mV . Adjust VR3 to achieve a Udif reading of 4000mV + 20mV.
- Reassemble the unit as detailed in Chapter 4. Re-check the voltage by again obtaining a service printout.

Service Screen

The service screen provides information of the patient cable and electrodes and gives the value of certain reference voltages and important internal offset values. These values are for information only. The service screen also gives variable settings and measurements that can be set by the service engineer; to carry out these adjustments some of the settings require additional test equipment. To call up the service screen press the following key sequence:

ALT - 0 - 3 - any number 0...6



ECG Reference Voltage

This provides measurements and setting facilities for the reference voltage used for accurate measurement of ECG signals

- Uref + This gives the value of the reference voltage used in the multiplexer circuit on the ECG Amplifier. The value of the reference voltage is 2000 mV ±20 mV.
- Uref - This is a negative reference voltage used on the ECG Amplifier board. The value of this voltage should be -2000 mV ±20 mV.
- Udif This is the sum of the two reference values above (Uref +and Uref -). This value must be 4000 mV ± 20 mV.
- Uoff This is the value of offset voltage on the multiplexer circuit. This value should be in the range ± 150mV
- Calib This value is the Udif value divided by 4. The nominal value is 1000 ±5 mV.

Service Screen (cont.)

Electrode dc offset

This gives the voltage drop in the patient cable and can indicate any faults in the patient cable or patient electrode. The value given is the dc voltage between the left leg electrode and all other electrodes. The measurements obtained will indicate any cable short circuits or open circuits. The measured voltage value will depend on where the electrodes are connected. The voltage readings that can be expected are as follows:

- With patient connected - ± 100mV
- With patient simulator connected - ± 20 mV - this will depend on the patient simulator used and must be taken as a flexible measurement.
- With all electrodes shorted together: - ± 20 mV
- No patient cable connected: -350 to -450mV

TPH TEMP

This is the measured ambient temperature that the processor uses to correct print quality.

This reading should be ambient temperature ± 5°.

EPROM

This is the checksum for the EPROM. Its value varies from one unit to another and may change after a software upgrade.

The software version of the unit and the options installed are printed on the bottom of all printouts. The only option available is the interpretation option; an **C** is printed. To obtain a printout of all settings press the following key sequence:

ALT- 0 - 1 - any number 0...9

Details of all settings are given in Chapter 1 of this book or in the AT-2 User Guide.

Software Options / Updates

Installing Software Options

To upgrade the AT-2 from standard to C version type the following:

ALT - 0 - 4 - update code (obtainable from SCHILLER)

Acceptance of the code is indicated by a series of beeps.

CAUTION

MORE THAN 10 ATTEMPTS TO ENTER THE INCORRECT CODE BLOCKS THE UNIT

Installing Software Updates

To update the operating software in the AT-2plus see instructions in Chapter 1 of this book.

Chapter 6
Spare Parts

Contents

Ordering Information ***6.2***
Service Department *6.2*
Spare Parts ***6.3***

Ordering Information

Your local representative stocks all the disposables and accessories available for the AT-2*plus*. In case of difficulty or to obtain the address of your local dealer, please contact the head office. Our staff will be pleased to help process your order or to provide any details for all SCHILLER products.

The address for advice is:

SCHILLER AG
Sales Department (Order Processing)
Altgasse 68
6340 Baar
Switzerland

Phone Number: ***+ (41) 41 766 42 42***

Fax Number: ***+ (41) 41 761 08 80***

When ordering, state that the order is for an AT-2*plus* unit and provide the following:

- Part Description
- Part Number
- Your Address

Service Department

If you need help from our service engineers, please contact the following number:

Fax Number: ***+ (41) 41 761 03 34***

If you contact us by fax, be sure to provide the following information:

- Serial Number for your AT-2*plus*
- Software versions for system, printer
- accessories used, model and cable number

Spare Parts

Description	*Part Number*
Mikroprocessor and power supply board MK 14-10	3.248 3
Keyboard MK 14-3B	3.248 2
RS-232 Interface board MK 14-11	3.248 5
LCD Module	4.600 062
Bottom housing	4.310 235
Top Housing	4.310 181
Paper tray and printer assembly complete	3.911 005
Paper tray	3.911 016
Main EMC shield	4.416 041
ECG EMC shield	4.416 025
RS-232 interface EMC shield	4.416 055
Mains socket complete	4.270 009
Mains fuse holder	4.210 049
Mains fuse - 200 mA/T	4.210 010
Mains fuse - 315 mA/T	4.210 032
Mains transformer	4.320 066
12 V lead acid battery	4.350 005 / 023
Printer motor complete	4.330 019
Thermal print head complete	3.911 015
Thermal print head	4.140 117
Printer cable	4.520 398
Printer roller	4.410 189
Potential equalisation stud (earth bolt)	4.260 377

Chapter 7
Technical Data

Contents

Technical Data ***7.2***
Available Configurations *7.3*

Technical Data

Technical data subject to change without notice.

Dimensions:	400 x 330 x 100 mm
Weight:	5.0 kg (5.35 kg with full paper tray)
Mains Supply:	100 to 115 / 220 to 240 VAC, 50/60 Hz
Battery:	Built-in 12 V lead-acid battery (rechargeable)
Battery Capacity:	4 hours normal use - 300 printouts
Power Consumption:	Recording: 40 VA max
Leads:	Standard / Cabrera
Paper Speed:	5 / 10/ 25 / 50 mm/s (direct)
Sensitivity:	5 /10 / 20 mm/mV, either automatically adjusted or manually selected
Chart Paper:	Thermoreactive, Z-folded, 210 mm wide, perforation 280 mm
Printing Process:	High-resolution thermal print head, 8 dots per mm / 200 dots per inch (amplitude axis) 40 dots per mm / 1000 dots per inch (time axis 25mm/s)
Recording Tracks:	6 channels, positioned at optimal width on 200 mm, automatic baseline adjustment
Automatic Lead Programs:	Printout of all 12 leads
Data Record:	Listing of ECG recording data
	Version C: ECG measurement results (intervals, amplitudes, electrical axes), Sokolow Index, average complexes with optional measurement reference markings, and interpretation.
ECG Storage:	Circular input memory for 10 s, 12-lead ECG.
Memory Option:	Memory for ca. 45 ECG recordings with transmission facilities over an RS-232 interface.
Frequency Range of Digital Recorder:	0 to 150 Hz (IEC)
	0 to 150 Hz (AHA)
ECG Amplifier:	Simultaneous, synchronous registration of all 9 active electrode signals (= 12 standard leads)
	Sampling frequency: 1000 Hz
	Digital resolution: 5 µV
	Dynamic range: ±9.5 mVAC
	Max. electrode potential: ±300 mVDC
	Time constant: 3.2 s
	Frequency response: 0.05 to 150 Hz (-3 dB)
	Input impedance: >2.5MOhms at 10Hz

Technical Data

Myogram Filter (muscle tremor filter)	25 Hz or 35 Hz, programmable (not active on averaged waveform). The stored ECGs can be printed with or without filter.
Line Frequency Filter:	Distortion-free suppression of superimposed 50 or 60 Hz sinusoidal interferences by means of an adaptive digital filter.
Patient Input:	Fully floating and isolated, defibrillation protected.
Safety Standard:	CF according to IEC and complying with the following
	RL 93/42/EEC
	EN 60601-1:1990
	IEC 601-1
	IEC 601-2-25:1993
	pr EN 1441:1994
EMC:	CISPR 11: 1985, EN 55011: 1992
	IEC 801-2: 1991
	IEC 801-3: 1984
	IEC 801-4: 1988
	IEC 801-5:
Safety Class:	I according to IEC 601-1 (with internal power supply)
	IIa according to RL 93/42/EEC, CE-0124
	This device is not designed for outdoor use (IP 20)
Environmental Conditions:	Temperature, Operating: 10° to 40°C
	Temperature, Storage: -10° to 50° C
	Relative humidity: 25 to 95% (non condensing)
	Atmospheric pressure: 700 to 1060 hPa
Control Panel:	Rubber keys

Available Configurations

The CARDIOVIT AT-2*plus* is available in several versions:

Standard Version:	Unit with ECG recording and printout capabilities.
Version C:	Unit with additional ECG Interpretation program (including measurements).
AT-2*plus* Memory:	Unit with FLASH EPROM memory and RS-232 or Modem communication interface.

Chapter 8
Glossary

Contents

Introduction *8.2*

Acronyms *8.3*

Introduction

The following list provides a glossary of the important signals and acronyms used in the circuit diagrams for the SCHILLER instruments. They will not all apply to the AT-2*plus Memory*.

Only abbreviations that are specific to SCHILLER equipment are included here. General electrical and electronic abbreviations are not included.

Acronyms

..OS	Offset signal (on the ECG amplifier).
A(1...n)	CPU Address Bus
ALBEEP	Alarm beeper signal to the audio amplifier. The frequency of this signal is about 1000 Hz.
ANA1, ANA2	Analog input from the experimental inputs DC1 and DC2
AS	Address strobe
BATT	Signal to CPU indicating battery operation
BATTLC	Analog signal to the processor giving the charge condition of the battery.
BATTV	Battery voltage - analog signal from the power supply used by the processor to assess battery or mains operation.
BLOW	Battery less than 11.3 V. LCD flashes when this signal is acrive. When the battery drops to below approximately 9.4 V the unit is switched off. These values apply to equipment with 12 V battery. For other equipment the limits are different.
CHAD..	ECG signal multiplexer control signals (on the ECG amplifier).
CIF(0..16)	Communication interface. General control signals for the communications interface circuits.
CI(0..10)	RS interface control lines - input.
CO(0..10)	RS interface control lines - output.
CL1	19 kHz LCD latch pulse.
CL2	3.11 MHz LCD clock frequency.
CLK..	Clock signal. The number following the CLK indicates the frequency. For example CLK19 indicates a frequency of 19 MHz.
CS..	Chip select. The general format of the chip select signals is CS followed by some characters. The characters indicate the device to which the chip select signal appertains. For example CSRTC is the chip select signal for the real time clock and CSEPROM is the select signal for the EPROM etc.
CTS	Clear to send. General signal used in data communication.
D(0..15)	Data bus.
DACWR	Digital / analog converter write.
DMUX	Data multiplexer.
DRAM	Dynamic RAM.
DRC(0..6)	Dynamic RAM control.
DS..	Data strobe.
DSP..	Digital signal processor (on program pack).

Acronyms

DTACK	Transfer data acknowledge. Bus signal to acknowledge transfer of data.
DTR	Outgoing serial data, turns modem ON.
ECGI	ECG in - serial ECG data to the CPU sent over the optical interface.
ECGMUX	The multiplexed ECG signal from the ECG amplifier.
ECGO	ECG out - serial ECG amplifier control data from the CPU sent over the optical interface.
EF	Empty flag.
EJCT	Eject (paper tray).
EKGRES	Reset signal to the ECG amplifier. This signal resets the ECG amplifier to recenter the ECG image on the LCD.
FIFOR	First in first out read
FLM	Control signal for frame synchronisation of the LCD.
FPIN	Input for floating point co-processor.
FWR	Flag read / write.
HREN	Output enable signal for thermal print head data (History enable).
HSYNC	Horizontal synchronisation (video / VGA output).
IPL0..2	Interrupt priority level (binary encoded).
IREG	Control signal from the current detector and limiter circuit on the power supply to regulate supply.
ISYS	Interrupt system (2 kHz).
KB..	Keyboard data in.
KBBEEP	Keyboard beep (to audio amplifier).
KBCLR	Keyboard clear.
KBCL1	Keyboard clock.
KBCL2	Keyboard clock.
KBIN	Keyboard data in - serial data from the keyboard to the CPU.
KBS..	Keyboard strobe.
KONV	Convert - this signal initiates the conversion of the incoming signal from the ECG amplifier.
LA	Left arm.
LEDB	Battery LED.
LEDMAINS	Signal indicating mains connected to operate LED indicator on the keyboard.
LCA	Liquid crystal address - enable.

Acronyms

LCD KONT	LCD contrast - sets the -18 V voltage level (from which the LCD backlight power is generated) and thus the contrast of the screen.
LD1,2,3,4	Lower LCD data.
LDS	Lower data strobe.
LOE	Lower output enable.
LP	Line synchronisation.
LSRAM	Lower output enable - control signal for static RAM.
LWE	Lower write enable.
M	LCD control signal derived from FLM.
MCLK	Motor clock - speed control for the printer motor.
MOD	Control signal from the battery charging circuit.
MOFF	Motor off.
MON	Motor ON - printer motor enable signal.
NWTZ	Mains supply.
NMI	Non-maskable interrupt - interrupt for U47 (Schiller gate array) activated by the reset button.
OFF	Off signal from the OFF key to switch off the power supply.
PDS	Control signal derived from FLM (unity waveform 1/2 FLM frequency).
PM	Paper mark signal.
PMARK	Paper mard detection signal.
PMPON	Pacemaker detection pulse.
PMNEG	Pacemaker negative - indicates the trailing edge of a pacemaker pulse.
PMPOS	Pacemaker positive - indicates the leading edge of a pacemaker pulse.
QTRRG	QRS trigger - output signal.
RA	Right arm.
RAS	Row address strobe.
RES\p	Error reset signal to inactivate the LCD.
RTS	Ready to send - outgoing serial data, handshake with CTS.
RXD	Receive data - incoming serial data.
R / W	Read / Write
RES	Reset.
RESLCD/	Resets / darkens the LCD.
SC(0..8)	System control bus - CPU control signals

Acronyms

SCINV	Screen inversion.
SO	Serial output from the CPU to the ECG amplifier via opto isolators.
SP..	Spirometry control and data signals.
SRAM	Static RAM memory.
STRB1/2	Timing signals for printer control.
SYSEN	System enable - active when the Program Pack is inserted. The CPU will not work if this signal is not active.
TGATE	Gate pulse for programmable timer. This signal sets the TPDUR signal.
TM	Thermal printer temperature - dc voltage from the print head, pulse width modulation of signal TPTH.
TPC	Thermal printer clock. This is not a continuous clock signal but is active when loading a line of printer data (into shift registers).
TPCLK	Thermal printer clock.
TPD	Thermal printer data - serial data for the printer.
TPDUR	Thermal printer duration - duration of the strobe pulse dependant on the ambient temperature of the print head and the resistance of the print head.
TPCSEL	Thermal printer controller select - control of thermal printer FIFO (input memory buffer).
TPL	Thermal printer latch - print strobe control and data latch signal.
TPRES	Thermal printer reset - FIFO reset for thermal printer controller.
TPS 0 & 1	Thermal printer strobe.
TPTH	Thermal printer temperature - dc voltage from the print head to ADC, approximately 3.7 V at room temperature.
TS	Temperature sense (from battery).
TXD	Outgoing serial data.
uPOFF	Off control signal. Logic 1 keeps the unit switched on, logic 0 switches the unit off. Note that the unit is initially switched on directly from the ON key on the keyboard.
U1,2,3,4	Upper LCD data.
+UB	Battery voltage.
UCAS	Upper column address strobe (for dynamic RAM).
UD1, UD2	Upper data strobe - used for generating UOE and UWE.
UDS	Upper data strobe - used on the Schiller gate array.
UOE, USRAM	Upper output enable - for static RAM.

Acronyms

+UP	Voltage rectified from the mains input and regulated to approximately +15 V.
UWE	Upper write enable.
+U	Unregulated dc supply from mains (approximately 30V).
+UBU	Back-up voltage for the real time clock and static RAM.
+UD	Unswitched regulated dc voltage used as power source for the switched supply +US. The voltage is 13.5 V when mains is connected, or battery voltage when mains is not connected. When mains is connected, this supply charges the battery.
-ULCD	Contrast voltage to LCD.
+US	Input voltage for all PSUs on the power supply board from the rectified mains or from the battery.
VCC	+5 V
VMA	Valid memory address.
VPA	Valid peripheral address.
VSYNC	Vertical synchronisation - (video / VGA output).
WP0 and WP1	ECG in - the serial multiplexed ECG serial data to the CPU sent over the optical interface, from the ECG amplifier.
XD0..XD3	Pixel information.
XSCL	Shift clock for XDn.
YD	Frame synchronisation.
YDIS/	LCD off.
ZEROSET	Baseline reset (on the ECG amplifier) from the processor.

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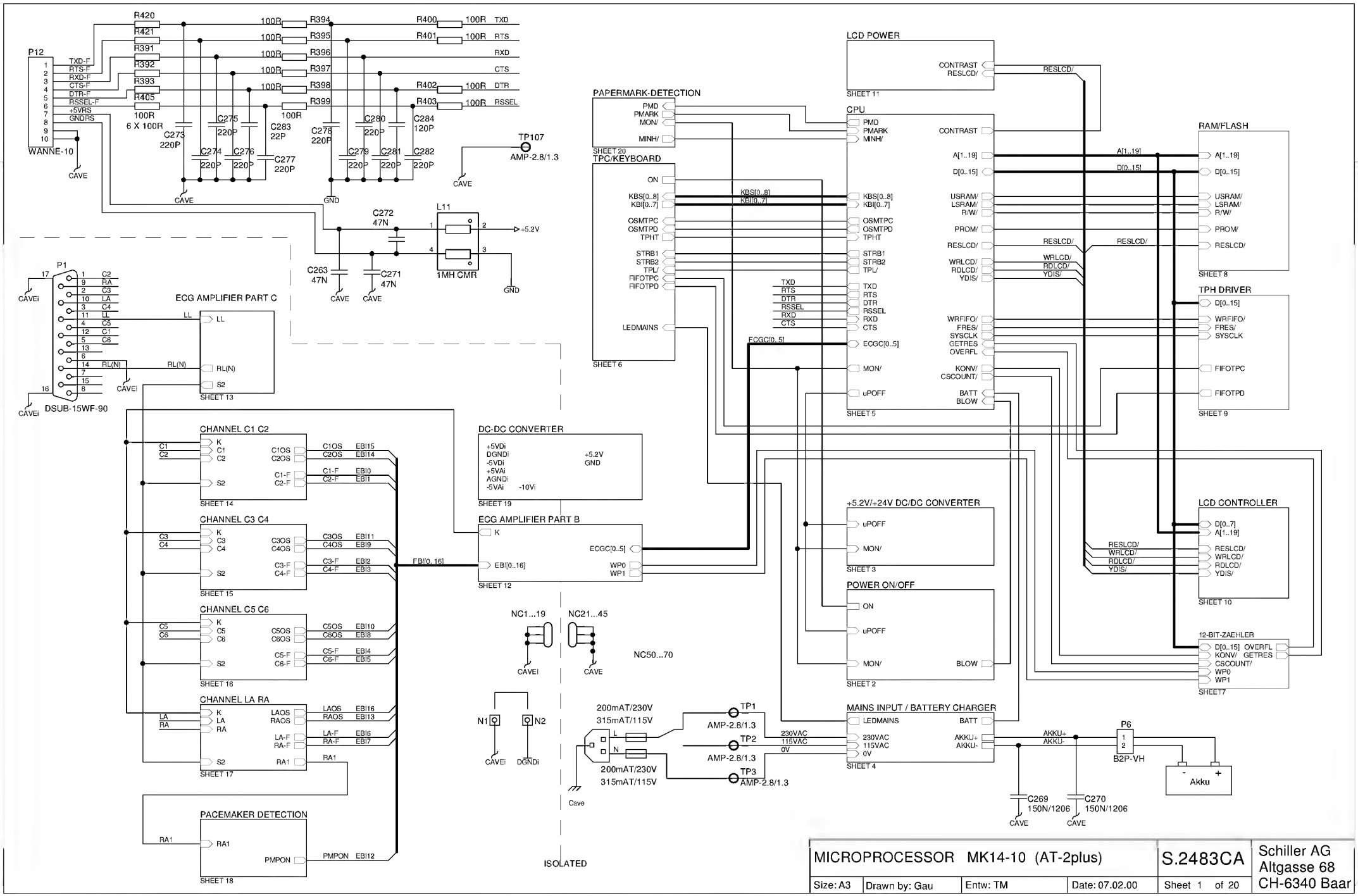
CAVEH091

KEYBOARD MK14-3 AT-2 plus				S.2482CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: AS	Date: 26.01.99	Sheet 1 of 1	


P12
WANNE-10
R420
R421
R391
R392
R393
R405
100R
6 X 100R
C273 220P
C274 220P
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C276 220P
C277 220P
C283 22P
R394
R395
R396
R397
R398
R399
C278 220P
C279 220P
C280 220P
C281 220P
C282 220P
C284 120P
R400 100R TXD
R401 100R RTS
RXD
CTS
R402 100R DTR
R403 100R RSSEL
TP107
AMP-2.8/1.3
CAVE
GND
C272 47N
L11
1MH CMR
+5.2V
C263 47N
C271 47N
P1
DSUB-15WF-90
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N2
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315mAT/115V
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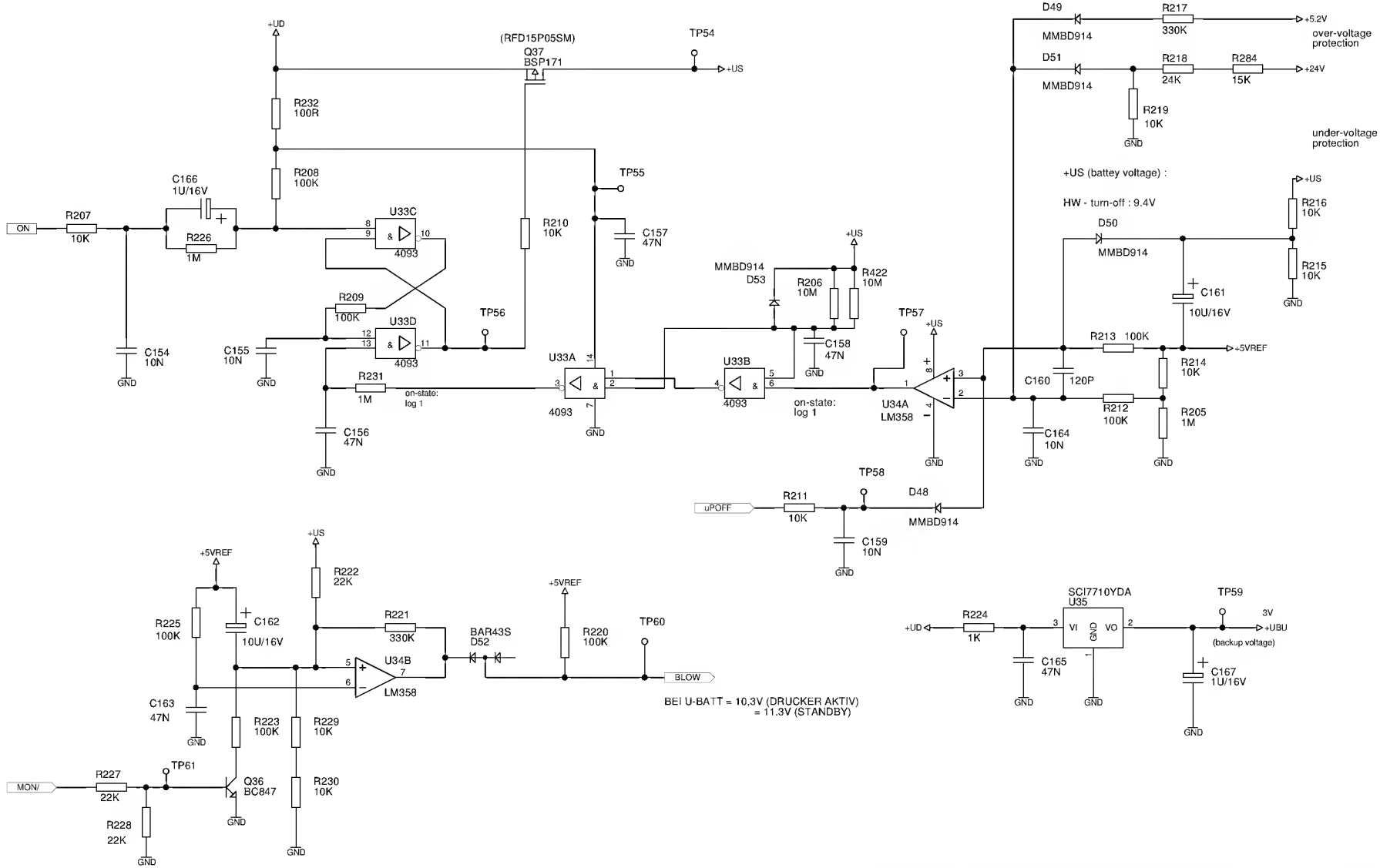
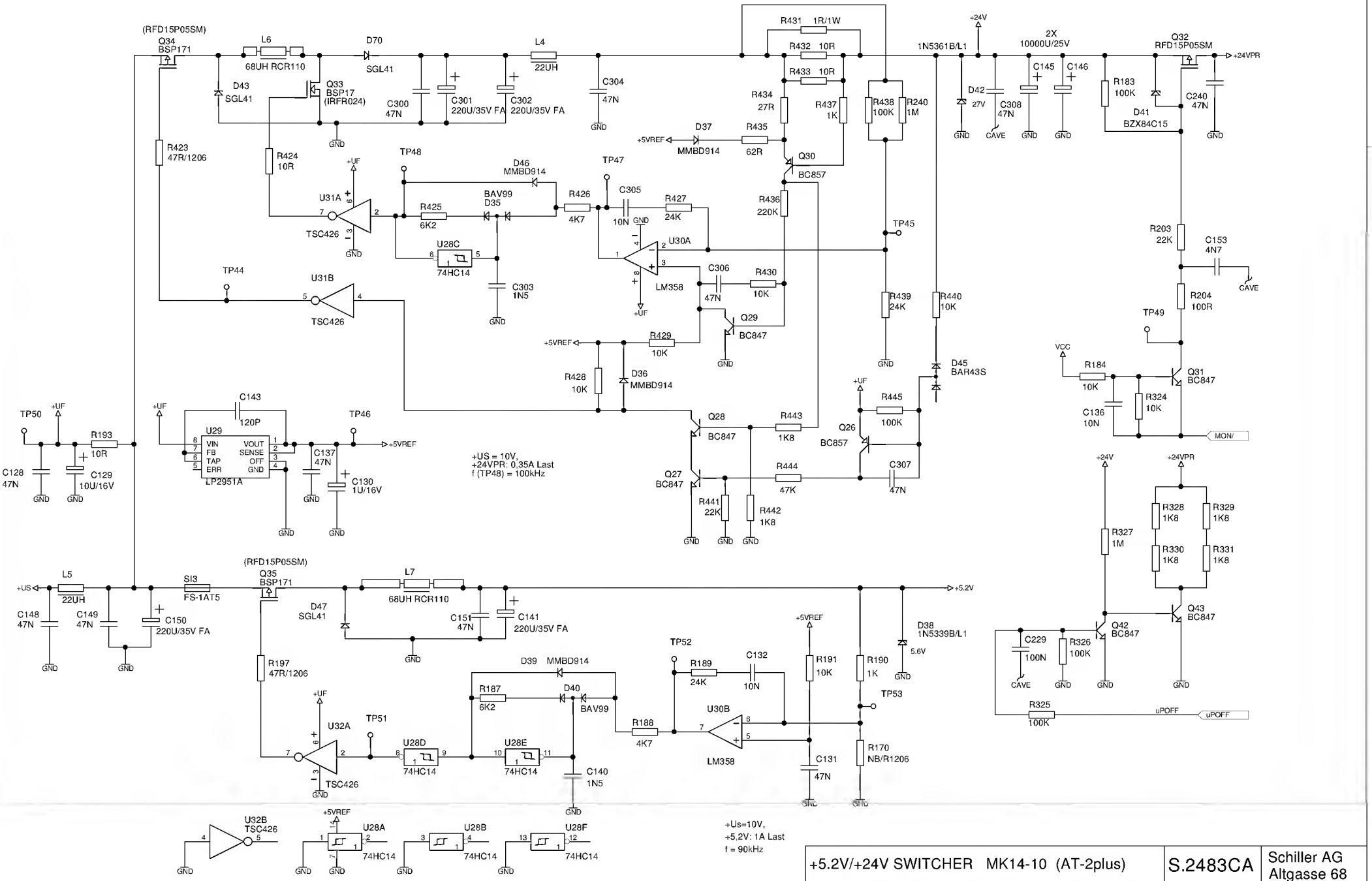
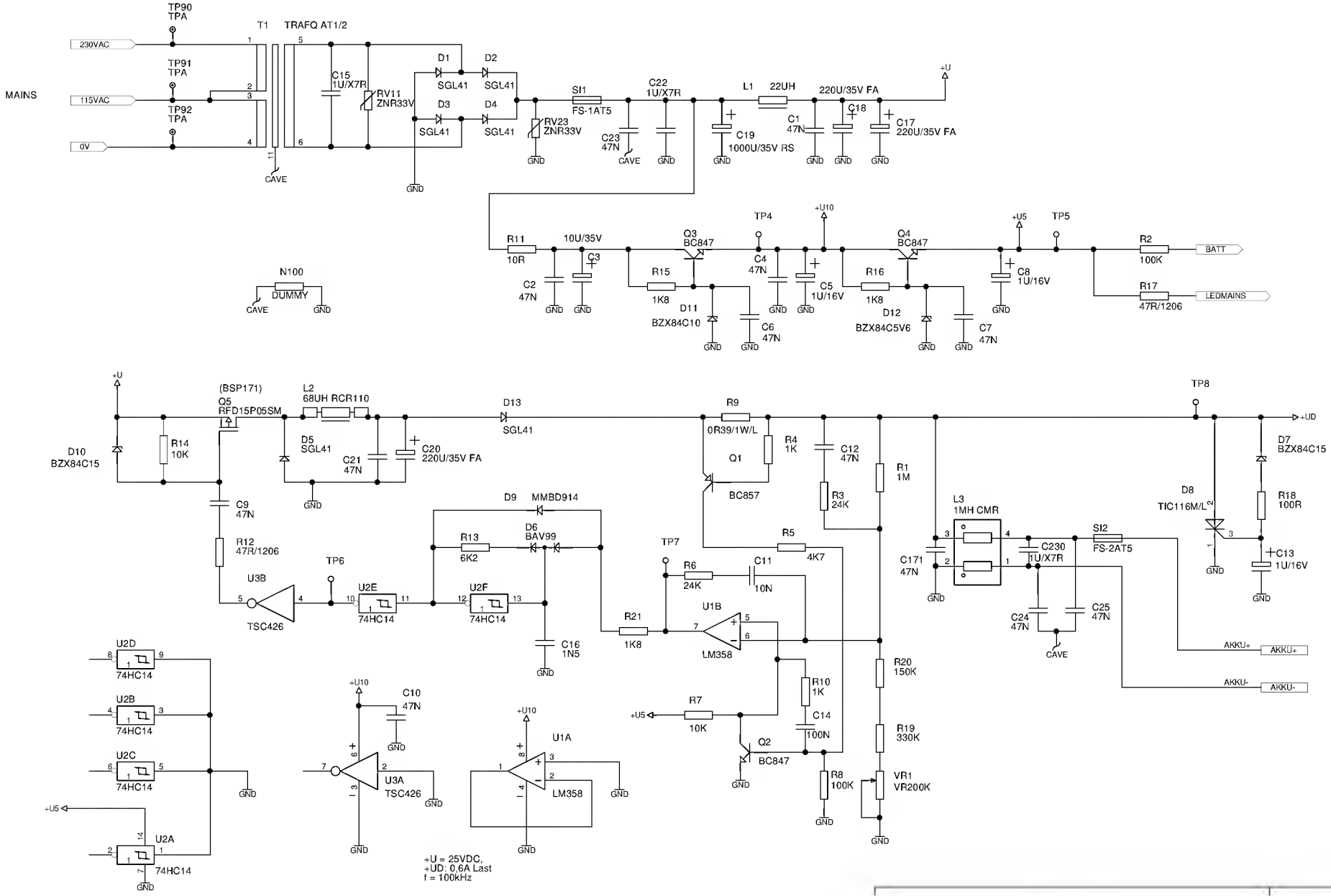
TP2
TP3
AMP-2.8/1.3
230VAC
115VAC
0V
Cave
PAPERMARK-DETECTION
SHEET 20
TPC/KEYBOARD
SHEET 6
LCD POWER
SHEET 11
CPU
SHEET 5
+5.2V/+24V DC/DC CONVERTER
SHEET 3
POWER ON/OFF
SHEET 2
MAINS INPUT / BATTERY CHARGER
SHEET 4
RAM/FLASH
SHEET 8
TPH DRIVER
SHEET 9
LCD CONTROLLER
SHEET 10
12-BIT-ZAEHLER
SHEET7
P6
B2P-VH
Akku
C269 150N/1206
C270 150N/1206
MICROPROCESSOR MK14-10 (AT-2plus)
S.2483CA
Schiller AG
Altgasse 68
CH-6340 Baar
Size: A3
Drawn by: Gau
Entw: TM
Date: 07.02.00
Sheet 1 of 20



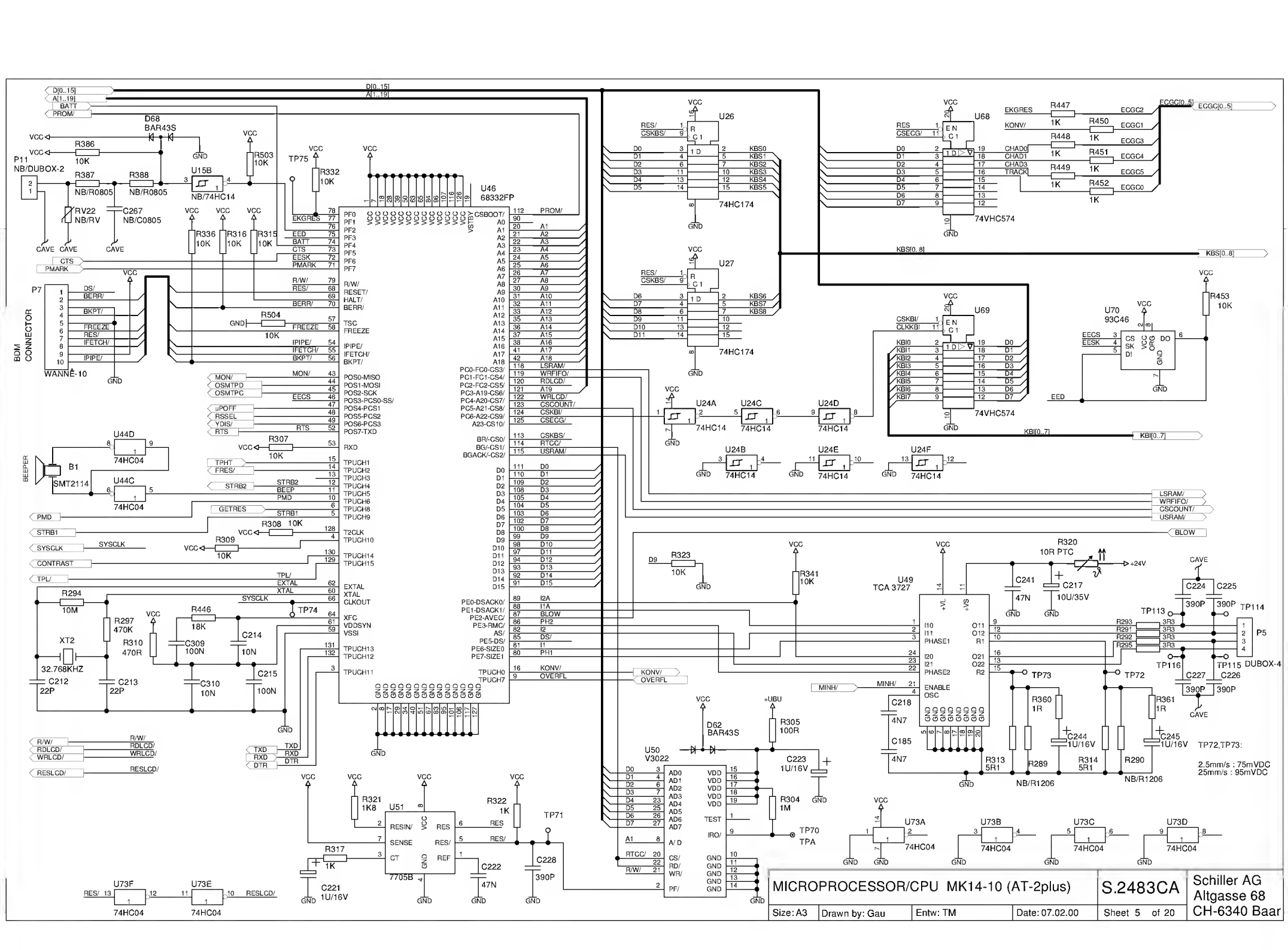
ON/OFF & BACKUP MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 2 of 20	

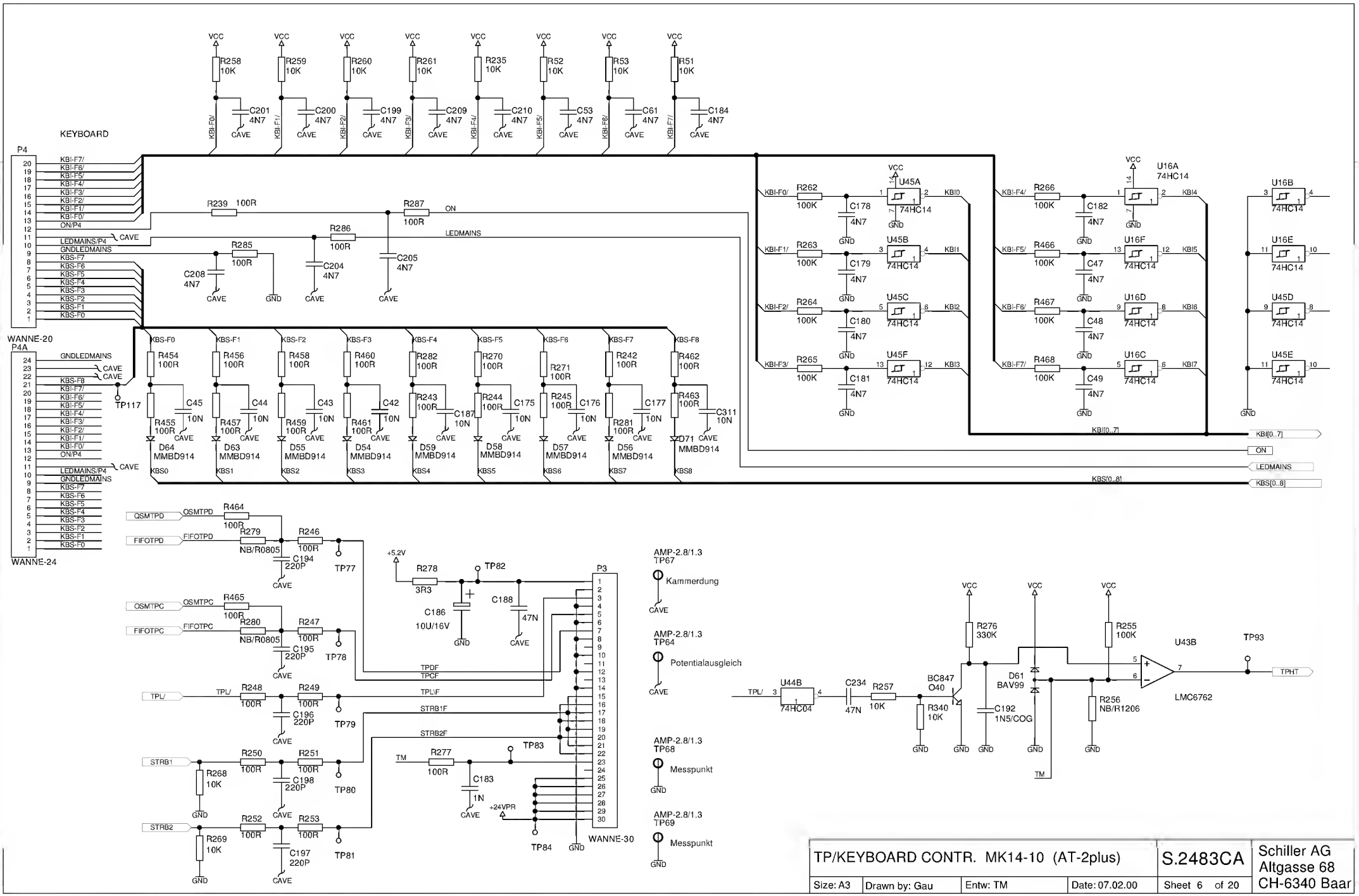


+5.2V/+24V SWITCHER MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 3 of 20	

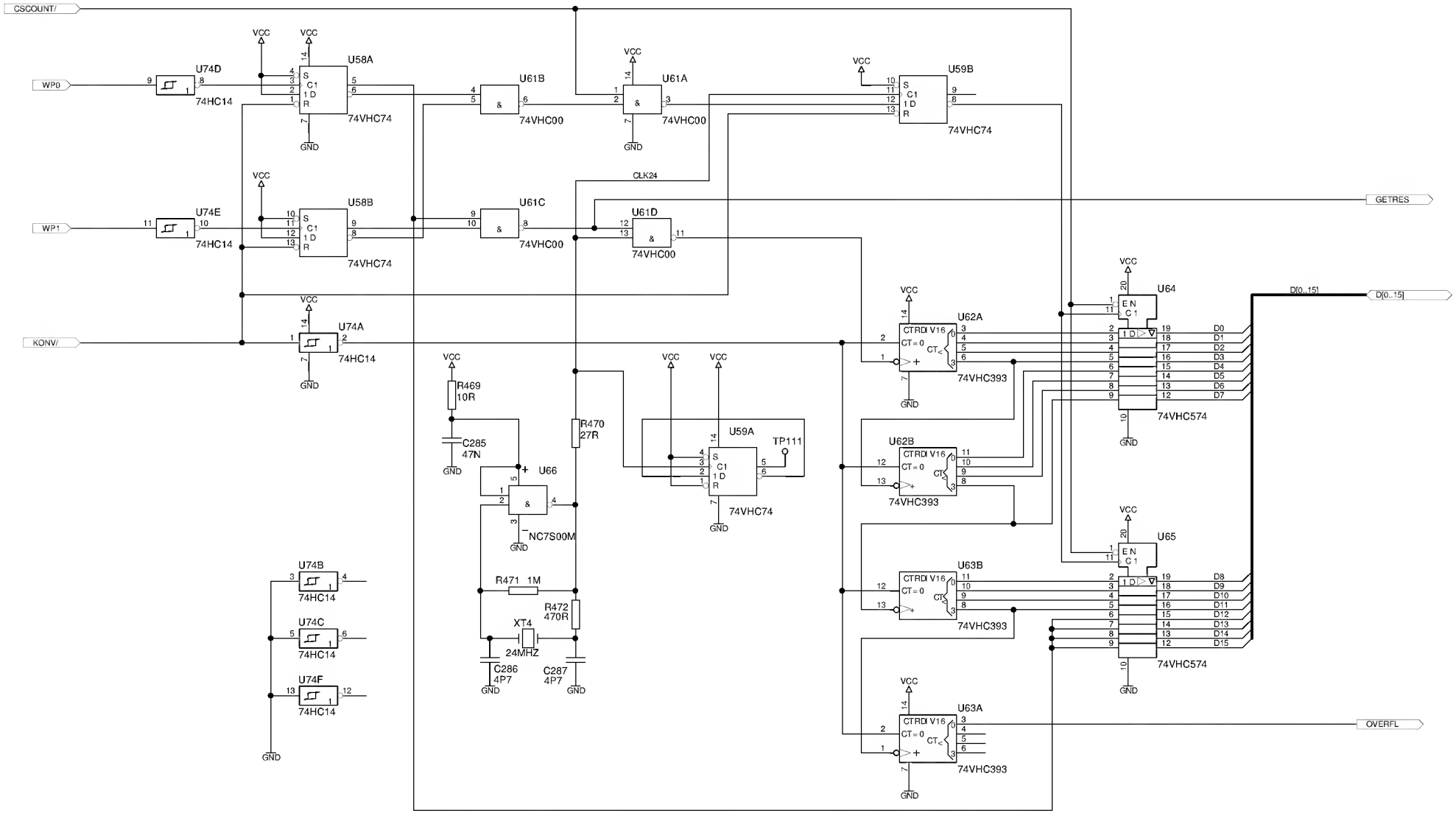


MAINS INPUT/BATT.CHARG. MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 4 of 20	

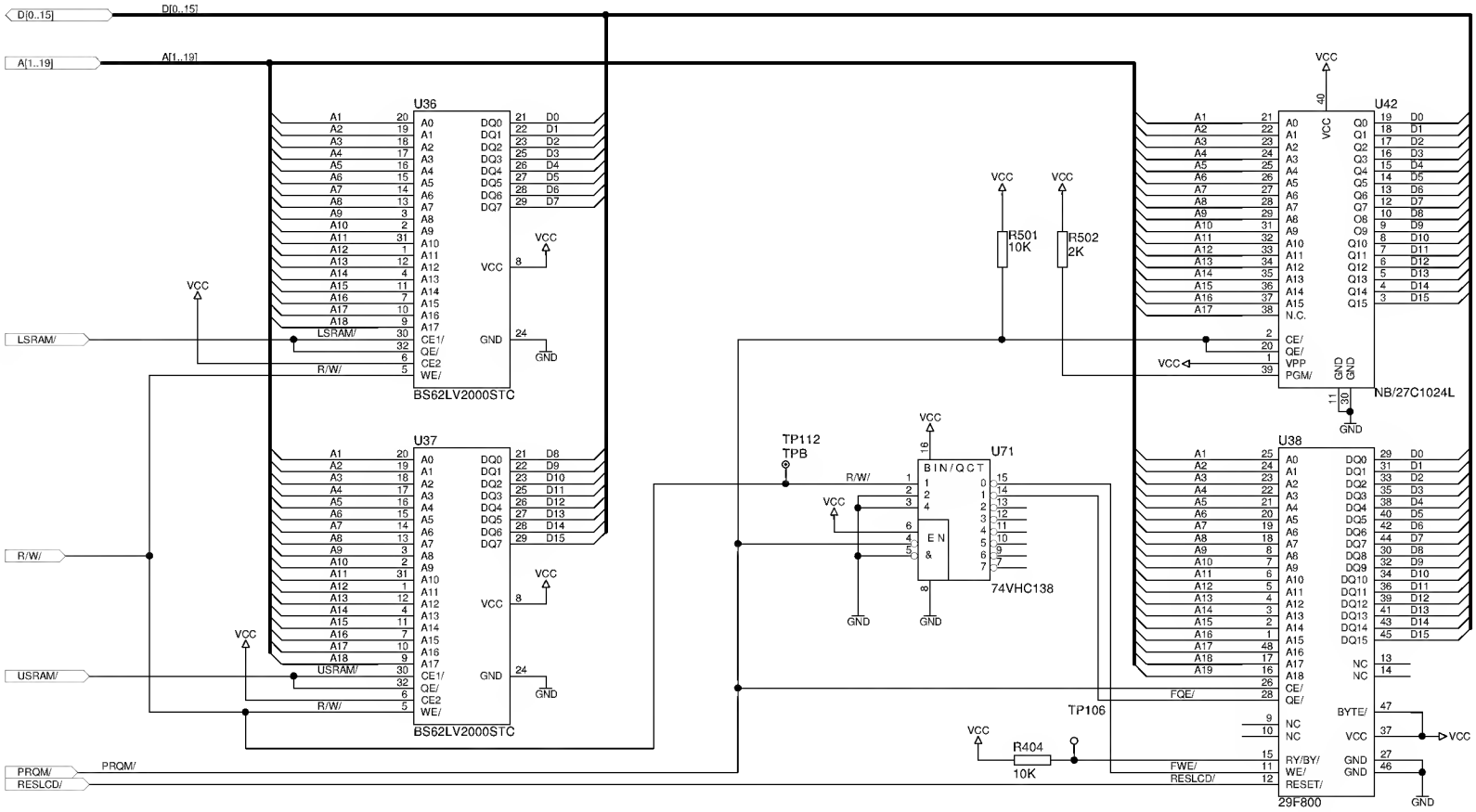

MICROPROCESSOR/CPU MK14-10 (AT-2plus)
S.2483CA
Schiller AG
Altgasse 68
CH-6340 Baar
Size: A3
Drawn by: Gau
Entw: TM
Date: 07.02.00
Sheet 5 of 20
U46
68332FP
U26
74HC174
U27
74HC174
U68
74VHC574
U69
74VHC574
U70
93C46
U49
TCA 3727
U50
V3022
U51
7705B
U15B
NB/74HC14
P11
NB/DUBOX-2
P7
WANNE-10
BDM CONNECTOR
P5
DUBOX-4
D68
BAR43S
D62
BAR43S
B1
SMT2114
BEEPER
XT2
32.768KHZ
TP71
TP72,TP73:
2.5mm/s : 75mVDC
25mm/s : 95mVDC



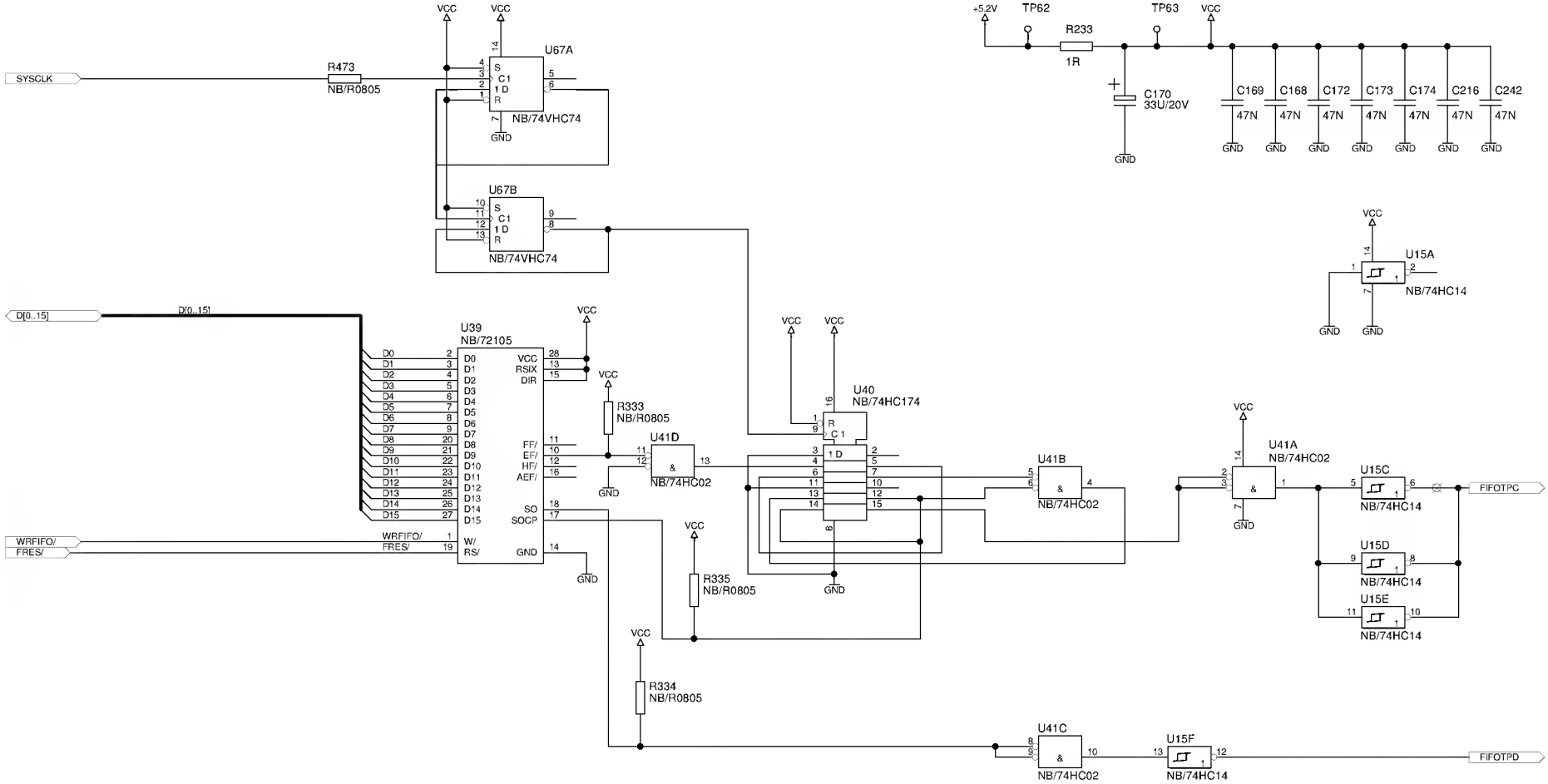
TP/KEYBOARD CONTR. MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 6 of 20	



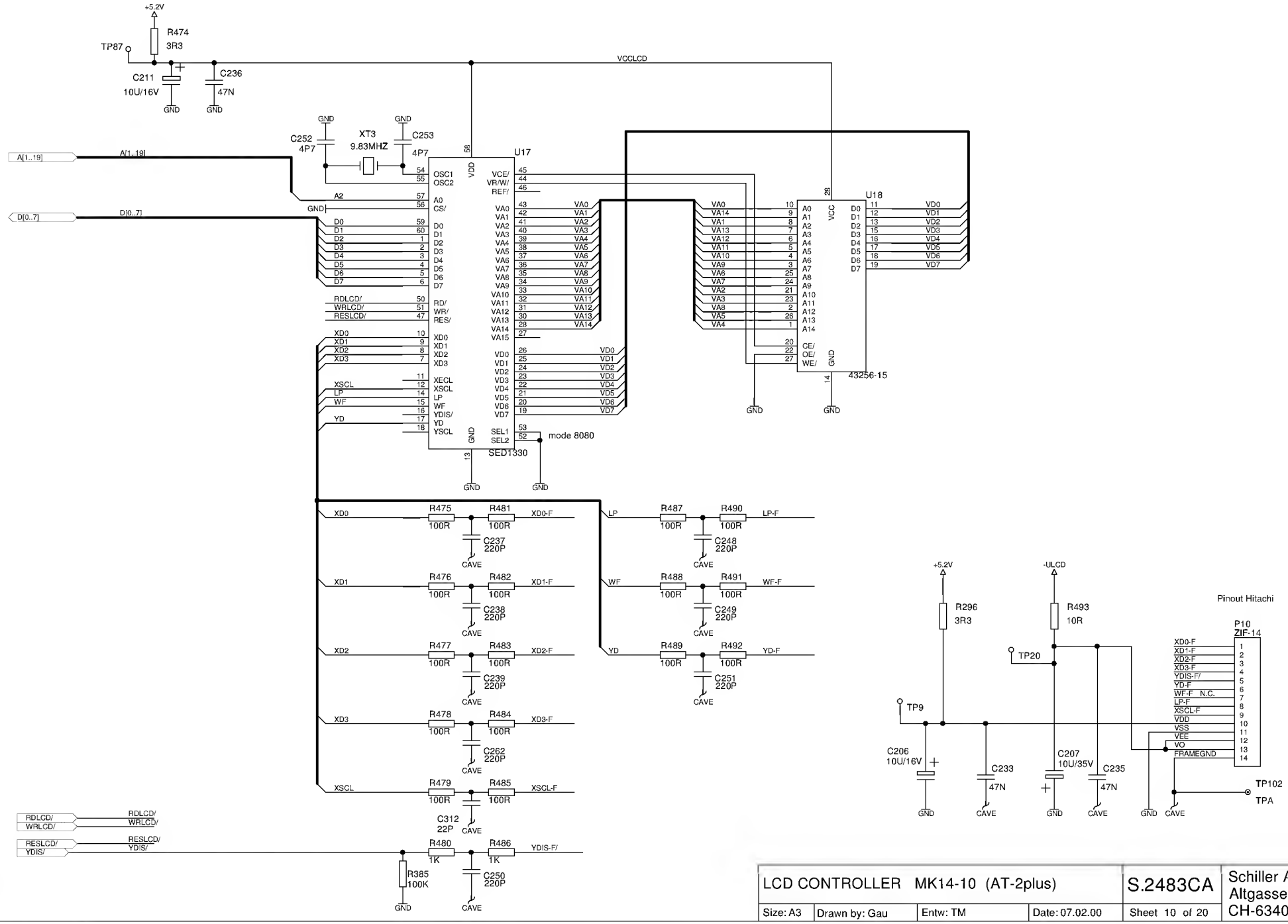
12-BIT-ZAEHLER MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 7 of 20	



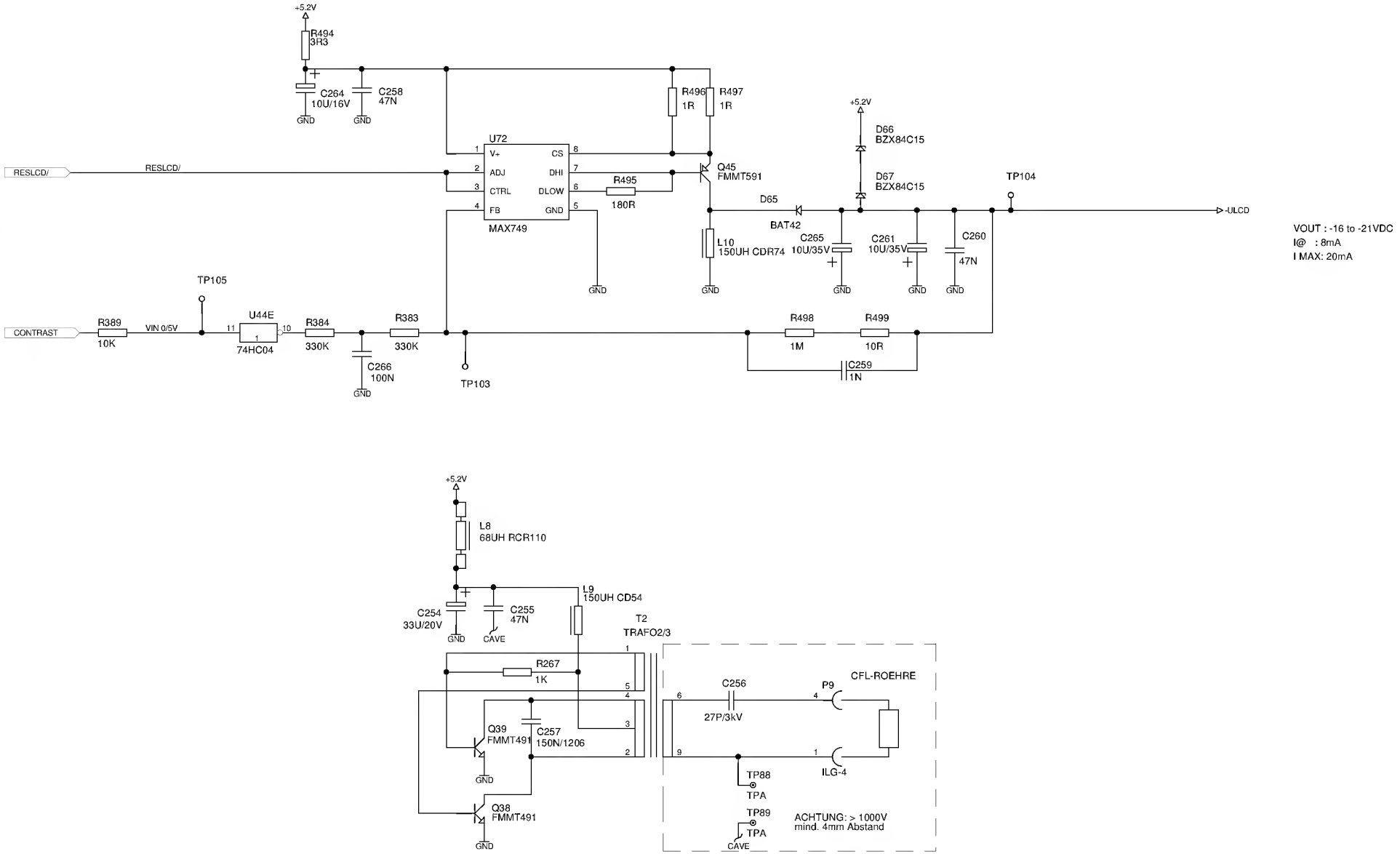
RAM/FLASH MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 8 of 20	



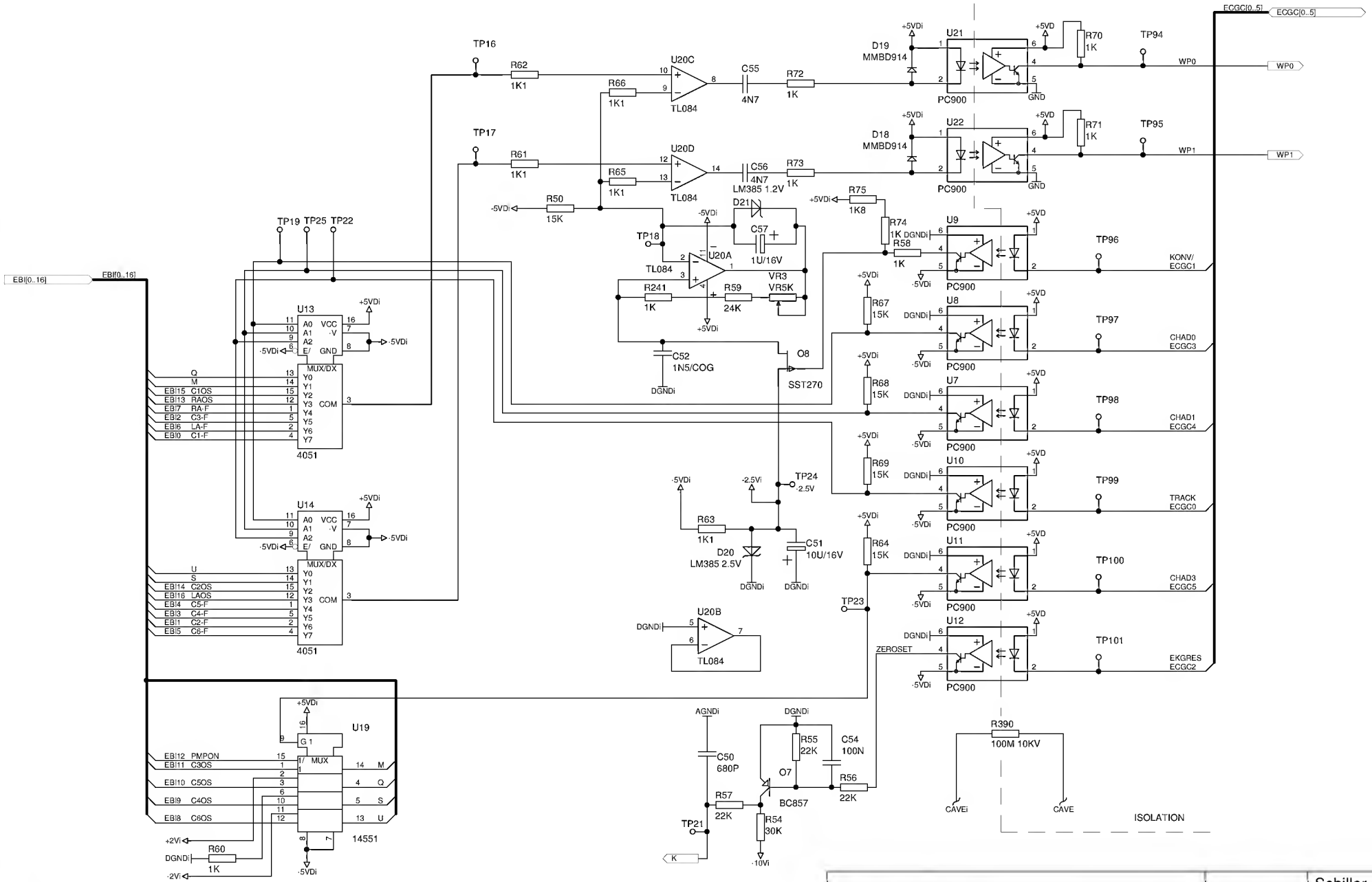
TPH DRIVER MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 9 of 20	



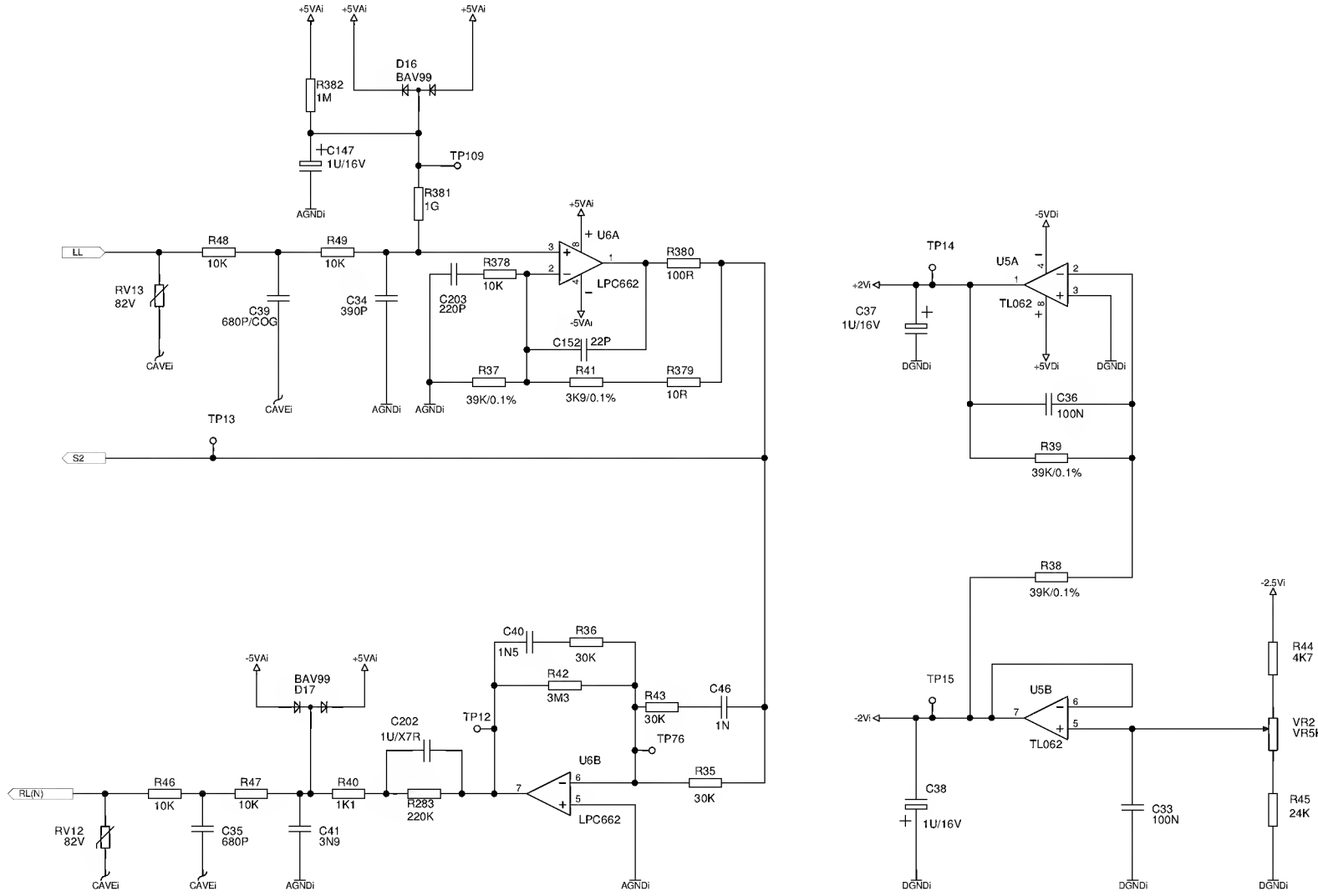
LCD CONTROLLER MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 10 of 20	



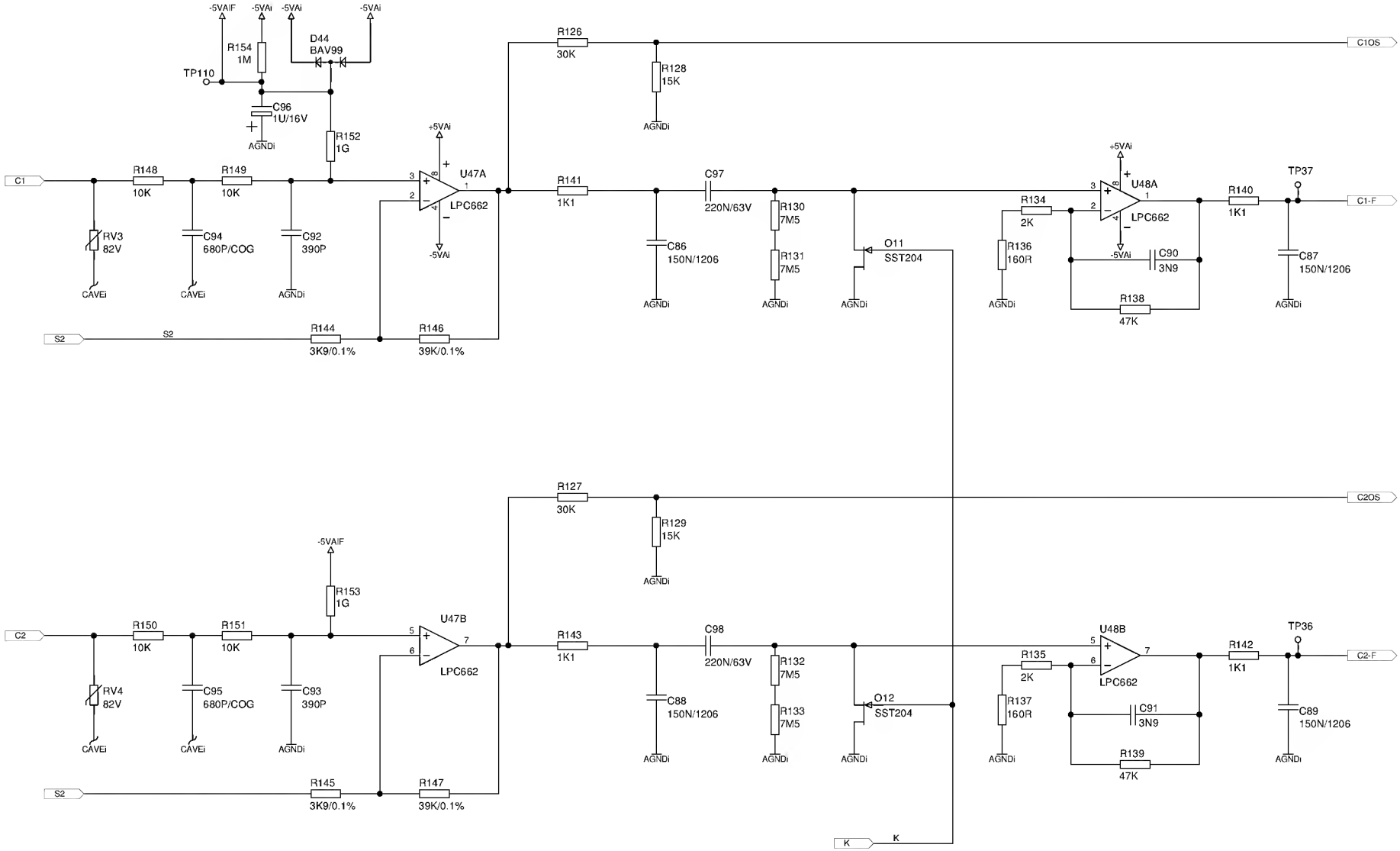
LCD POWER SUPPLY MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 11 of 20	



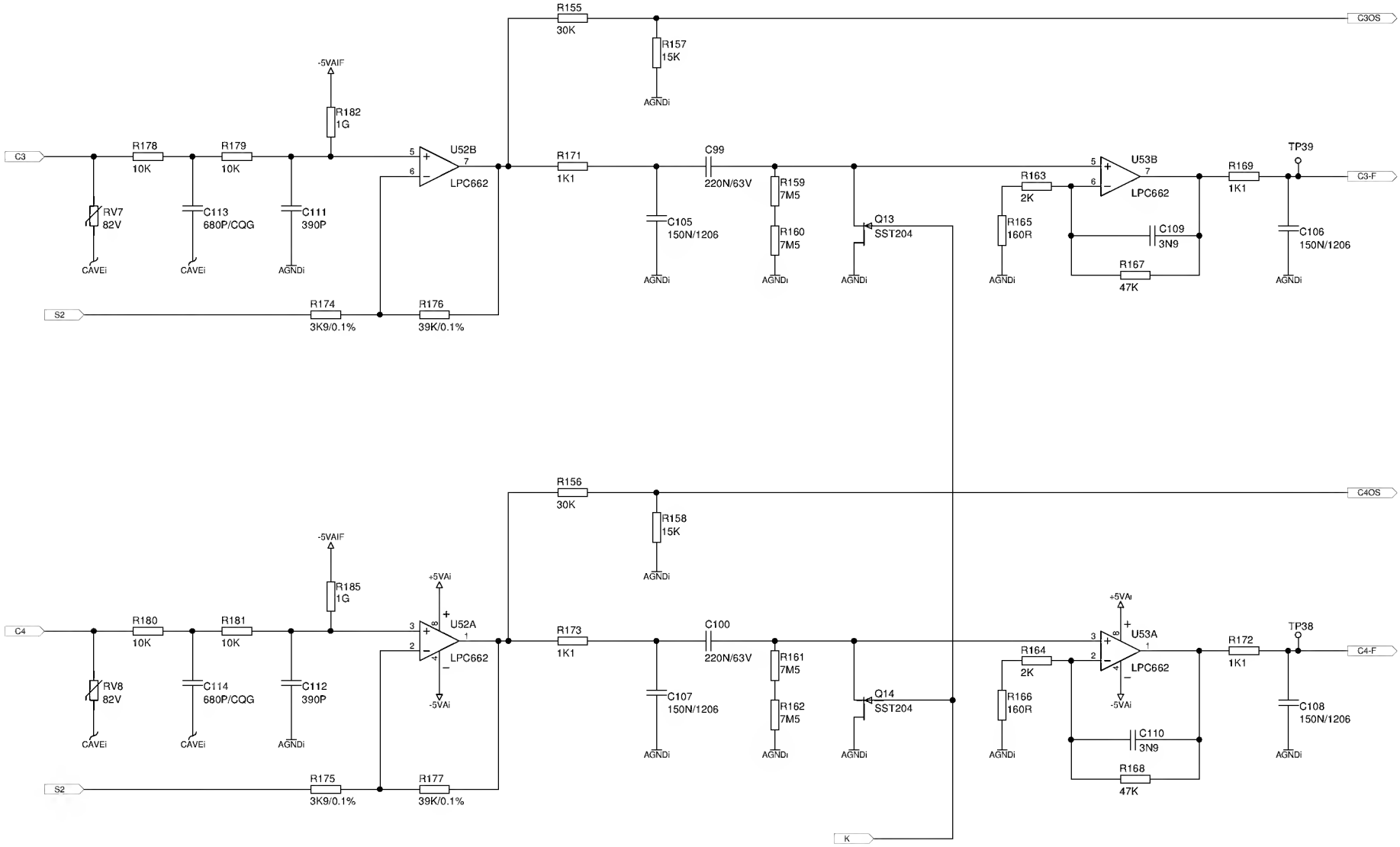
ECG Part B MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 12 of 20	



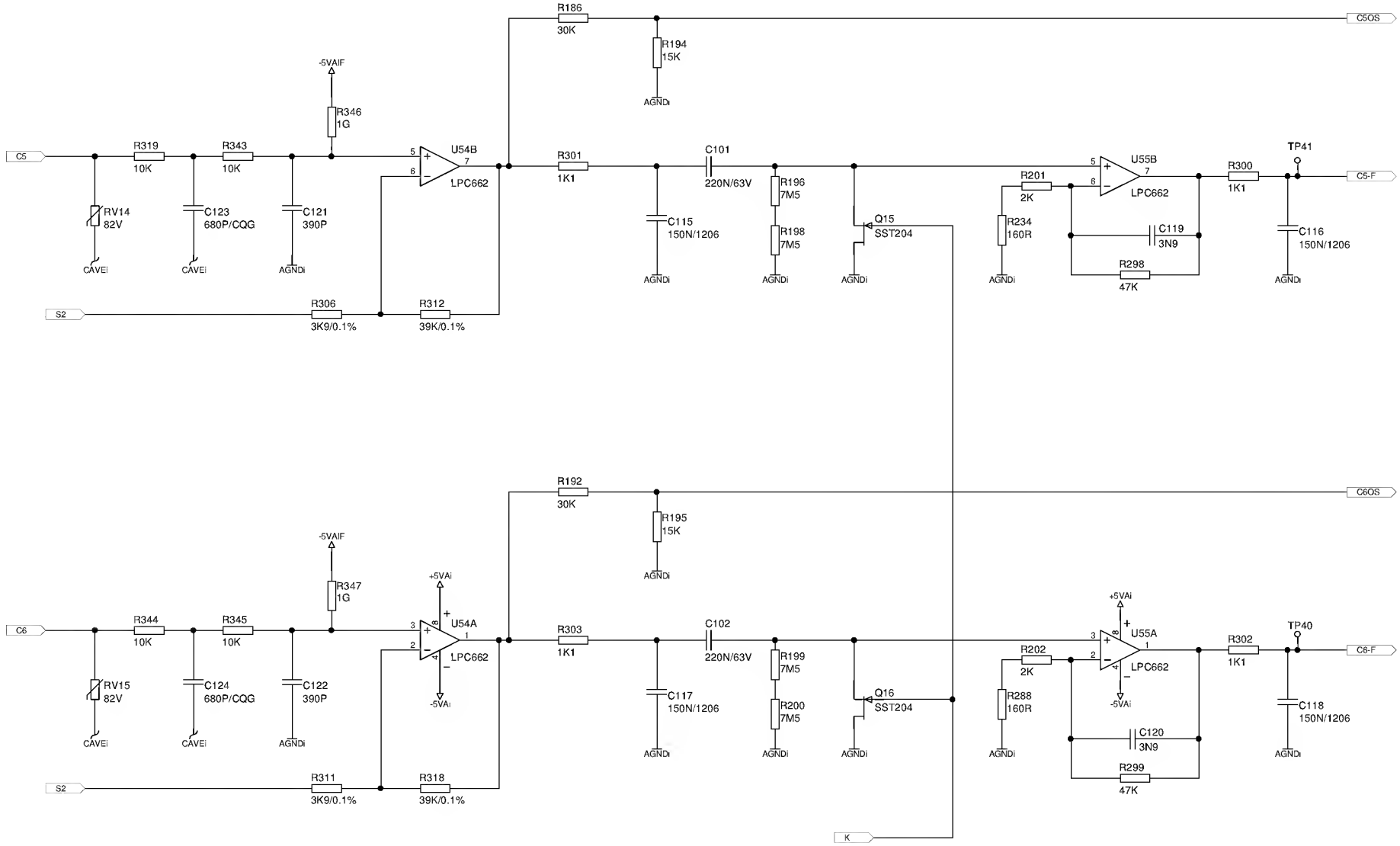
EKG Part C MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 13 of 20	



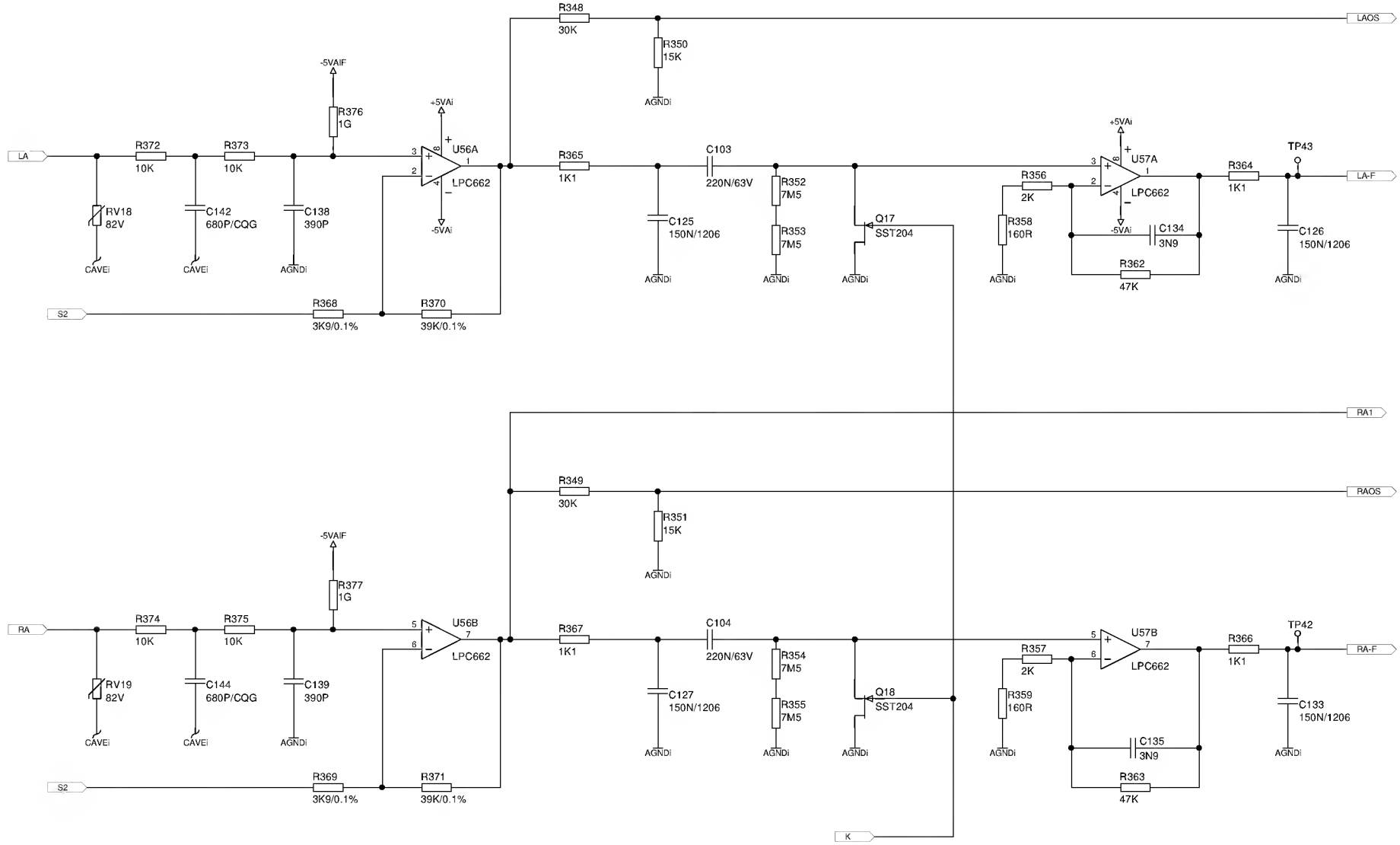
ECG CHANNEL C1+ C2 MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 14 of 20	



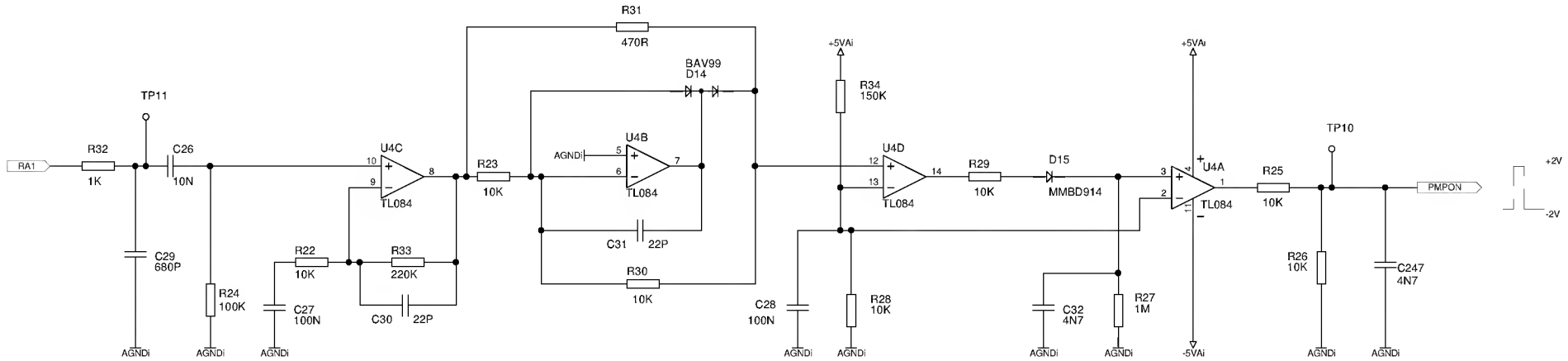
ECG CHANNEL C3 + C4 MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 15 of 20	



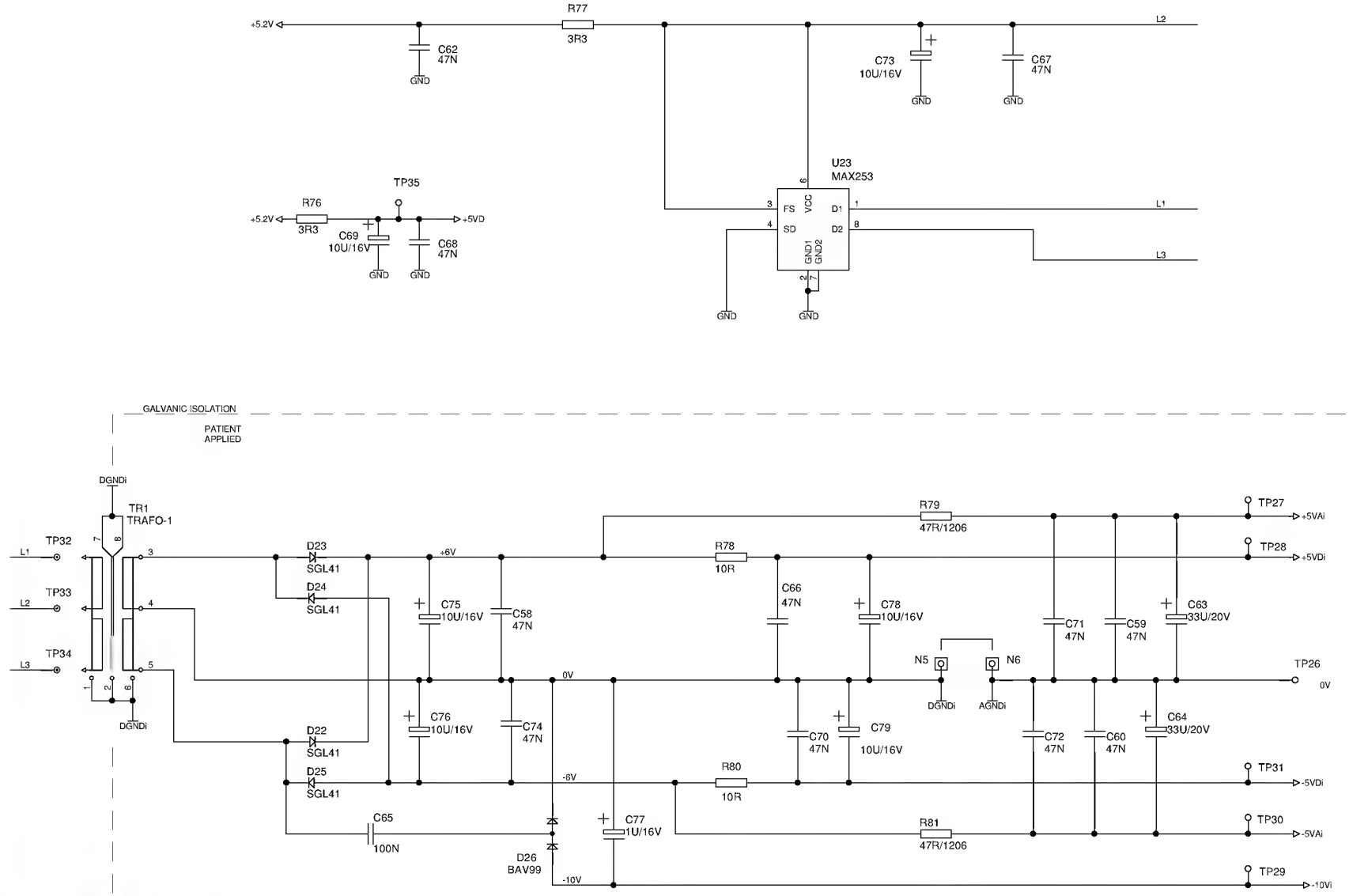
ECG CHANNEL C5 + C6 MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 16 of 20	



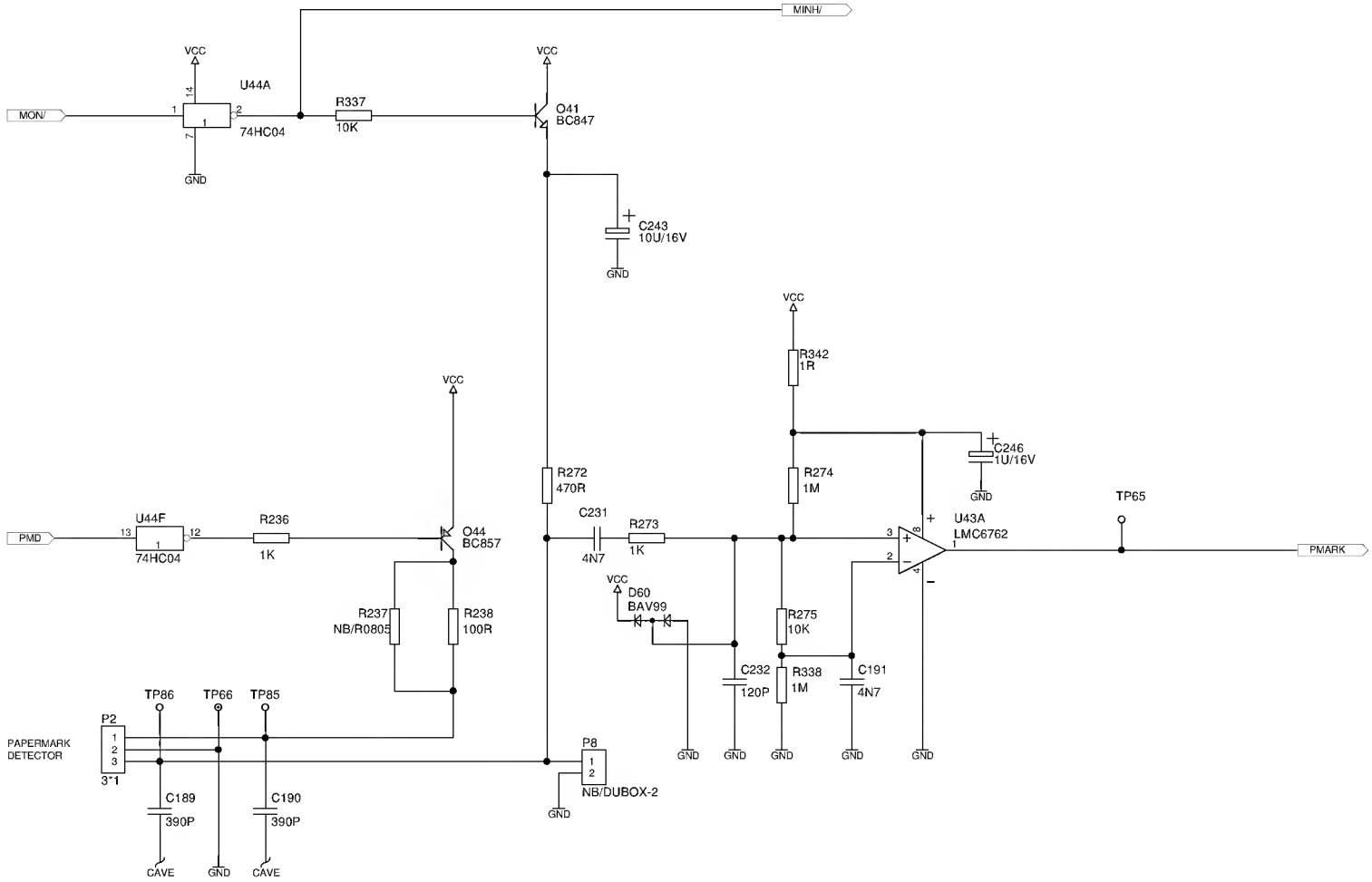
ECG CHANNEL LA + RA MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 17 of 20	



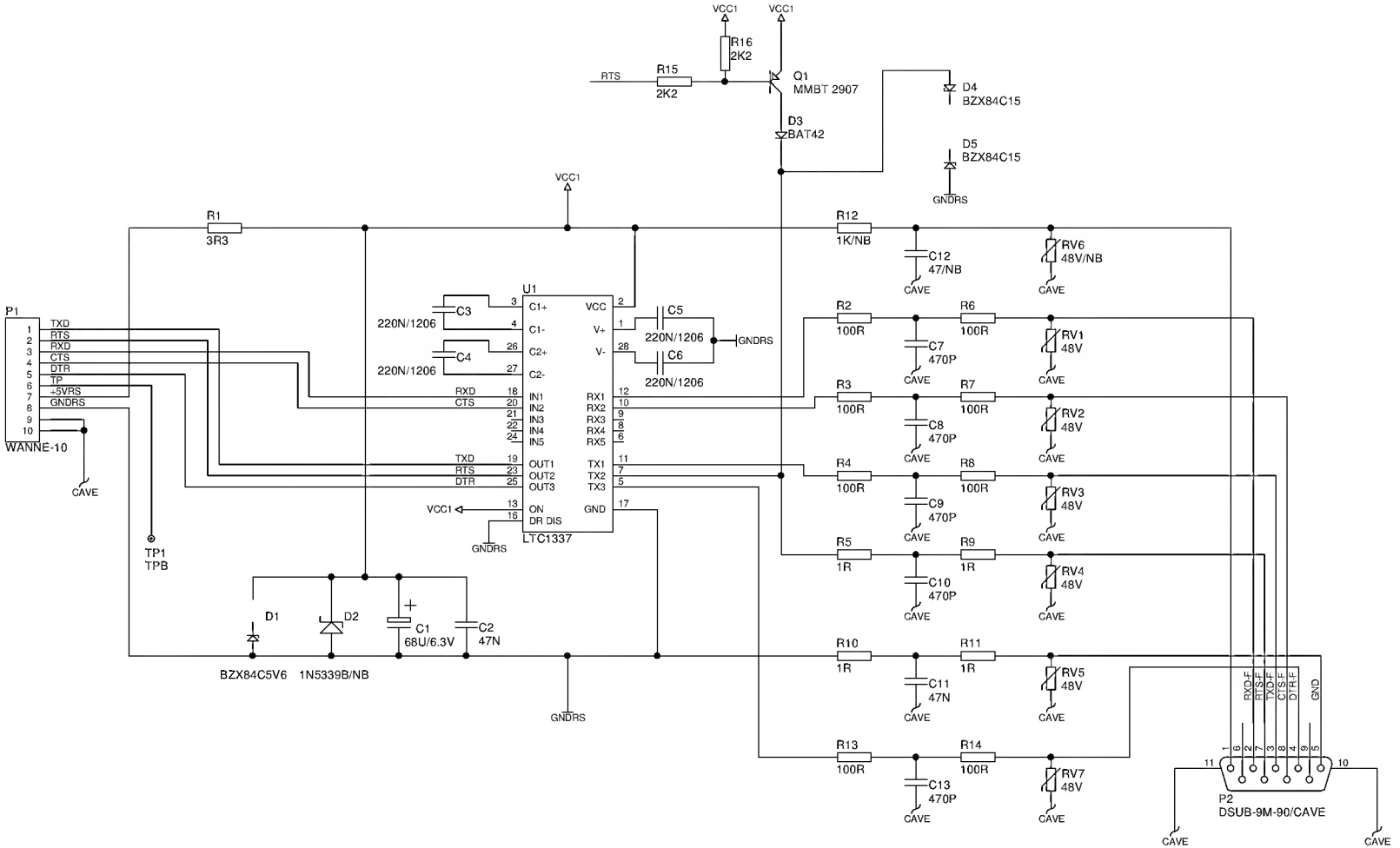
ECG PACEMAKER TRIGGER MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 18 of 20	



DC-DC CONVERTER (EKG) MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 19 of 20	



PAPERMARKER MK14-10 (AT-2plus)				S.2483CA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: Gau	Entw: TM	Date: 07.02.00	Sheet 20 of 20	



Interfaceboard RS-232		MK14-11 (AT-2Plus)		S.2485BA	Schiller AG Altgasse 68 CH-6340 Baar
Size: A3	Drawn by: STR	Entw: Ben	Date: 14.01.1997	Sheet 1 of 1	